Vol. XXI June, 1961 No. 12

DISSERTATION ABSTRACTS

ABSTRACTS OF DISSERTATIONS AND MONOGRAPHS IN MICROFORM

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Vol. XVI (13) July 1955-June 1956
XVII (13) July 1956-June 1957
XVIII (7) July 1957-June 1958

DISSERTATION ABSTRACTS is published monthly by University Microfilms, Inc., 313 North First Street, Ann Arbor, Michigan. Subscription rates are: a. *Dissertation Abstracts* alone for 12 issues without annual index: $27.50 in the United States; $30.00 foreign; b. a combined subscription to *Dissertation Abstracts* with the 13th index number, paper bound as the other issues: $34.50 in the United States; $37.50 foreign; c. the *Index to American Doctoral Dissertations* alone, bound in hard covers: $8.00 in the United States; $9.00 foreign.

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AGRICULTURE, GENERAL

EFFECTS OF FERTILIZATION ON GROWTH, YIELD, CHEMICAL COMPOSITION AND PROCESSING QUALITY OF POTATOES.

(L. C. Card No. Mic 61-1829)

Tarun Kumar Ghosh, Ph.D.
Cornell University, 1960

Experiments were conducted to study the effects of four different rates of nitrogen with potassium chloride and potassium sulfate as different sources of potash. Variety used was Katahdin.

No significant difference in fresh weight of shoot due to different potash source was observed. In general, increasing nitrogen applications produced better vine growth.

Potassium sulfate produced more tubers than potassium chloride. Highest number of tubers were obtained from plots receiving 120 pounds nitrogen per acre in 1958 whereas in 1959, 180 pounds application produced more tubers per plant.

No significant difference in total weight of tubers per plant was observed between chloride and sulfate. Applications of 120 pounds nitrogen per acre produced higher weight of tubers per plant compared to 60 and 180 pounds applications, which were both superior to no nitrogen treatment in 1958. No significant difference was observed among nitrogen treatments at the last date of sampling in 1959.

Plants from potassium sulfate treated plots contained more nitrate nitrogen compared to potassium chloride at equivalent rates of nitrogen applications. Increasing nitrogen application increased the nitrate nitrogen content of plant petioles. Potassium content increased with increasing age of the plants.

Average yields of U. S. No. 1 tubers were higher with chloride than with sulfate in 1958, whereas in 1959 it was the reverse. Neither the differences in yield of tubers (U.S. No. 1) in field tests nor in sand culture due to different sources of potash were significant. Increasing nitrogen applications increased the yields in sand culture and in 1958 field experiments. In 1959, 120 pounds nitrogen per acre treatment showed a highly significant superiority over all other treatments.

It was observed that 120 pounds nitrogen per acre was sufficient for maximum yield of U. S. No. 1 tubers when potassium chloride was used, whereas with sulfate 180 pounds nitrogen produced better yields in a wet season, and in drier a year 120 pounds nitrogen per acre yielded best.

Potassium sulfate proved to be better than potassium chloride in increasing specific gravity of tubers. Applications of 180 pounds nitrogen significantly lowered the specific gravity of tubers in 1958 when potassium chloride was used. Effects of other nitrogen treatments were not significant in other years or in combination with potassium sulfate.

Potassium sulfate produced tubers with higher dry matter content than potassium chloride. Applications of 180 pounds of nitrogen to the acre reduced the dry matter of tubers at harvest.

No consistent difference in chip color of tubers at harvest due to potassium chloride and potassium sulfate was observed. Lower application of nitrogen tended to produce chips slightly lighter in color but the differences were not enough to be considered important for practical purposes. Chips were lighter in color in a drier year compared to a wet growing season.

Chips from tubers stored at 50°F. were lighter in color compared to the tubers stored at 40°F. Potassium sulfate produced lighter colored chips compared to potassium chloride at higher nitrogen applications and after storage and reconditioning.

Except for the higher reducing sugar content in tubers from 40°F. compared to 50°F. storage, tubers from all other treatments were low in reducing sugar. It could be possible that non reducing sugar and basic amino acid contents of tubers might result in slight differences in chip color obtained in other treatments.

The growing season of 1959 was comparatively dry which might have been the cause of the inconsistency of some of the results obtained between the two years.

Microfilm $2.75; Xerox $6.20. 128 pages.

AGRICULTURE, ANIMAL CULTURE

EFFECTS OF ADRENALECTOMY IN THE CALF AND SOME INVESTIGATIONS OF ADRENAL STEROIDS IN BOVINE BLOOD

(L. C. Card No. Mic 61-119)

Victor Liné Estergreen, Jr., Ph.D.
University of Illinois, 1960

Investigations on the functions of the adrenal glands in dairy cattle were carried out using two approaches: (1) adrenalectomy, to study its effects on the animal on various blood components, and the therapy measures necessary to maintain the adrenalectomized animal; and (2) determination of the adrenal steroid hormones in blood of intact normal cattle.

Three calves, 3 weeks to 5 months of age, were bilaterally adrenalectomized in two stages at least 2 weeks apart. A special surgical technique was adopted, making use of a Herrick kidney clamp, for removal of the adrenal glands from their intimate attachments to the posterior vena cava without the necessity for suturing the vein.

The adrenalectomized calves were maintained, under controlled conditions, with daily intramuscular injections of 25 mg. cortisone acetate of 5 mg. prednisone, plus

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

5 mg. DOCA per 100 lb. body weight. They were also maintained in apparently normal condition without steroid therapy by free choice feeding of salt.

Adrenal deficiency symptoms appeared in 3-4 days, and survival time was about 6-7 days following withdrawal of maintenance therapy. The deficiency symptoms began with a noticeable lethargy and a progressive weakness in the legs, followed by anorexia, extreme apathy, a completely prostrate position, and extreme depression and arrhythmia of the heart shortly before death. One calf, upon autopsy, was found to have an adrenal remnant which prevented it from succumbing completely to the effects of adrenalectomy.

In all three calves there was a decrease in the serum Na:K ratio from a mean range of 13.7-16.9 before, to 9.0-9.9 after withdrawal of therapy measures. Serum chloride levels dropped from means of 350-451 mg.% to 291-370 mg.% and serum potassium increased from means of 21.5-25.7 mg.% to 29.0-44.2 mg.% during these same periods. These changes were all significant within each of these calves.

In two of the calves the serum sodium levels were greatly depressed (from means of 314-363 mg.% originally, to 278-281 mg.% during the deficiency period). In the third calf the serum sodium levels remained high during the deficiency period, but this was accompanied by extremely high serum potassium levels which resulted in a considerable drop in the Na:K ratio.

Two of three calves exhibited a reduction in blood total reducing substances and total neutrophils, and an increase in eosinophils and red blood cells following adrenalectomy. The influence of adrenalectomy on the serum calcium, blood hemoglobin and hematocrit levels varied considerably between calves and no significant changes were found in the levels of total white blood cells, lymphocytes or monocytes.

In the blood steroid investigations in normal cows, either whole blood or plasma was extracted and after purification, the steroids were separated by paper chromatography. Colorimetric and isotopic dilution techniques were used to estimate the quantities of steroids present in the blood. Three ultraviolet absorbing zones, "X", "F", and "B" were found. The "X" zone could not be identified but it was characteristically more polar than cortisol, strongly absorbed ultraviolet light, reacted strongly with blue tetrazolium and reacted weakly with phenylhydrazine hydrochloride.

The "F" zone chromatographed like authentic cortisol and did not separate when mixed with the authentic steroid. It also reacted strongly with both blue tetrazolium and phenylhydrazine hydrochloride indicating the presence of a dihydroxy-acetone side chain. The "B" zone chromatographed like authentic corticosterone and did not separate from a mixture with the authentic compound. This substance reacted strongly with blue tetrazolium but only weakly with phenylhydrazine hydrochloride.

The levels of cortisol ("F" zone) found in normal cows, were 1.6-6.4 and 2.2-17.2 micrograms per 100 ml. whole blood and plasma, respectively, after correction by the isotopic dilution technique. The levels of corticosterone ("B" zone) were 5.75 and 3.4-13.4 micrograms per 100 ml. whole blood and plasma, respectively, following isotopic dilution correction. Both cortisol and corticosterone increased following ACTH administration.

Microfilm $2.75; Xerox $5.60. 115 pages.

APPETITE STUDIES IN DAIRY CATTLE: GRASS SILAGE VS. HAY.

(L. C. Card No. Mic 61-1949)

Donald Hillman, Ph.D.
Michigan State University, 1959

Major Professor: C. A. Lassiter

Three trials were conducted during a two-year period to determine the affects of feeding rations of all hay, all silage, and hay-silage combinations ad libitum on dry matter consumption, milk production, and body weight changes of lactating dairy cows. The alfalfa hay and alfalfa silage used in each trial were harvested from the same field at the same stage of maturity.

In the first trial two equalized groups of eight milking Holstein cows were used in a 42-day reversal experiment to compare the affects of all-hay and all-silage rations. Cows fed all hay averaged consuming 34.3 pounds of dry matter daily, 3.14 pounds of dry matter per 100 pounds of body weight, gained 19.4 pounds of body weight, and averaged 28.3 pounds of milk per day. Respective values for cows fed all silage were 27.0, 2.46, -42.4, and 28.4. Differences in dry matter intake and body weight changes between rations were highly significant ($P < .01$).

Blood sugar levels of cows fed hay were significantly higher ($P < .05$) than of cows fed all silage.

In a 40-day 4 x 4 latin square feeding trial when wet hay (soaked in water to approximate the moisture of the silage) and silage that was treated with sodium hydroxide (NaOH) to increase the pH to approximately that of the hay were compared to dry hay and the alfalfa silage, neither the wet hay nor the NaOH-treated silage had any affect on dry matter consumption, body weight changes, or milk production.

When silage was fed ad libitum and hay feeding was controlled to 0%, 25%, 50%, 75%, and 100% of the ration dry matter, in each case additional increments of hay to the ration resulted in an increase in average daily dry matter consumption in a 90-day continuous trial. The average daily dry matter intake and dry matter intake per 100 pounds of body weight were 26.2 and 2.44 pounds, 28.6 and 2.70 pounds, 32.8 and 2.97 pounds, 35.1 and 2.99 pounds, and 41.0 and 3.52 pounds for cows fed the 0%, 25%, 50%, 75%, and 100% hay rations, respectively.

Dry matter intake per 100 pounds of body weight was significantly greater for cows fed all hay or the 75% hay plus silage ration than for cows fed all silage or 25% hay plus silage ration ($P < .01$). Differences between other rations were not significant at the one per cent level. However, at the five per cent level, the all-hay, 75%-hay, and 50%-hay rations were significantly greater than the all-silage ration; and the all-hay ration was significantly greater than the 75%-hay, 50%-hay, or 25%-hay rations.

Milk production of the cows fed all hay, 75% hay, and 50% hay was significantly greater ($P < .01$) than of cows fed 25% hay plus silage or all-silage rations. There were no significant differences in milk production between the all-silage and 75%-silage rations or the all-hay, 75%-hay, and 50%-hay rations at either the one per cent or the five per cent levels of significance.

The correlation between dry matter intake and milk production for all cows was $r = .572$. Changes in body weight were: all silage, -58 pounds; 75% silage, -20 pounds;

50% silage, -5 pounds; 25% silage, +51 pounds; and all hay, +23 pounds during the 90-day period. These differences were significant at the ten per cent level of probability. Microfilm $2.75; Xerox $4.80. 94 pages.

THE EFFECTS OF FEEDING EQUALIZED INTAKES TO MATURE AND IMMATURE SHEEP AT DIFFERENT FREQUENCIES

(L. C. Card No. Mic 61-1831)

Allen Huff Rakes, Ph.D.
Cornell University, 1960

Four experiments were carried out in order to study the effects of frequency of feeding on the utilization of feed by sheep of two different degrees of maturity and to obtain various physiological measurements expected to be useful in interpreting them. In the first two experiments twelve growing and four adult wethers were used to compare the effects of feeding once daily and those of feeding eight times daily on the body weight changes, the digestibility of energy and nitrogen, the urinary nitrogen excretion rate, the heat production and the pH of the rumen contents. In the third experiment six wethers were used to determine the effect of complete isolation on the heat production of animals fed only once daily. The effects of feeding one, four, and eight-times daily on the diurnal respiratory exchange variations, the urinary excretion of creatinine, urea, and total nitrogen by five yearling wethers were measured in the fourth experiment.

In Experiment I the growing animals fed eight times per day gained 65 percent more body weight ($P < 0.01$) and excreted 20 percent less urinary nitrogen ($P < 0.01$) than the ones fed only once daily. Although trends toward higher nutrient digestibilities and lower heat production by the frequently-fed growing animals were noted, these differences were not statistically significant at the five per cent level of probability. The averages of the rumen pH values for the animals fed once and eight times daily were not statistically significant, but much more drastic fluctuations in these measurements were observed in the animals fed only once daily. In Experiment II no significant differences attributable to differences in feeding frequency were observed in any of the previously named measurements on the adult wethers.

The animals fed once daily in isolated quarters in Experiment III exhibited diurnal heat production curves which were significantly different from those of the sheep housed in the presence of frequently-fed animals ($P < 0.01$). However, no significant differences in the total daily heat production of the two different treatment groups were observed.

In Experiment IV trends toward lower total nitrogen and urea levels in the urine of the wethers were noted when they were fed more frequently. However, these differences were not statistically significant. Different feeding frequencies did not alter the levels of creatinine in the urine. The diurnal variations in oxygen consumption of the animals fed on the different regimes are given and their possible significance discussed.

Microfilm $2.75; Xerox $5.20. 104 pages.

I. THE VALUE OF PELLETED ROUGHAGES IN RATIONS FOR FATTENING BEEF CATTLE. II. THE USE OF ULTRASONICS IN THE ESTIMATION OF RIB EYE AREA IN LIVE BEEF CATTLE.

(L. C. Card No. Mic 61-1421)

Max VanNess Wallentine, Ph.D.
Cornell University, 1960

Part I. Substituting pellets consisting of 1/2 alfalfa meal and 1/2 corn meal for ground corn and soybean oil meal in a fattening ration produced similar gains for beef calves. Feed consumption was similar for both rations but feed efficiency was five percent less for the ration with pellets. The feed replacement value of the alfalfa-corn pellets, as fed, for producing gains was 92 percent of the corn and soybean oil meal.

Alfalfa hay pellets fed with ground corn in the ratio of 1:1 or 2:1 produced similar gains in beef calves. Feed consumption was similar for both rations but feed efficiency was 5.1 percent less for the ration containing two parts pellets.

Considering both trials, feed efficiency tended to be greater for rations containing the higher level of concentrates. However, average gain, grade and selling price were not significantly influenced by the substitution of alfalfa pellets for one-half or two-thirds of the corn. The amount of finish tended to be slightly less on rations containing more roughage but there was no difference in the appraised market value at the end of the experiment.

Pelleted mixed hay of average or lower quality was substituted for 40 percent or 60 percent of the ground corn fed to yearling steers grazing on pasture. Gains on the two levels were not significantly different but tended to be slightly lower at the 60 percent level of pellets. Grades were also slightly lower at the high level of pellets and an appraised price differential between the three lots indicated that the cattle fed only corn were fatter. The gains and grades of the cattle fed 50 percent mixed hay pellets and those fed all corn were satisfactory and similar. The feed replacement value of the mixed hay pellets, as fed, for producing gains was 74 percent of the value of ground corn.

Part II. Rib eye area and fat thickness were determined by recording photographically a cross sectional ultrasonic scan at the 13th rib of each of 82 head of slaughter cattle and 141 head of Angus and Hereford breeding cattle of various ages. Correlation of carcass fat thickness with ultrasonic (1.0 mc) fat measurements gave a coefficient of +.50 ($P < .05$) for 18 slaughter cattle. Comparison of ultrasonic rib eye areas with carcass rib eye areas in 64 head of the cattle gave a correlation coefficient of +.43 ($P < .01$). These correlations, although significant, are believed to be too small to make the present ultrasonic method practical for predicting carcass rib eye areas and hence as a tool in selecting beef cattle.

Limited data suggest that positional variation in carcass area between the last two ribs is a partial explanation for the lower correlations with ultrasonic rib eye area. Variability in fat thickness, pressure during probing, and sonic velocity in fat are probable factors

accounting for variations in rib eye depth and hence area. Further investigation of these factors is necessary.

In breeding cattle, average ultrasonic rib eye area was positively correlated with average type score (+.92, $P < .01$) and muscling score (+.84, $P < .01$). Ultrasonic rib eye area was positively correlated with ultrasonic fat thickness (+.79, $P < .01$), in breeding cattle, possibly as a result of a slower speed of sound in fat than in lean which would result in apparently larger ultrasonic rib eye areas for fatter cattle. Comparison of carcass rib eye area and fat thickness for 18 slaughter cattle gave an expected negative correlation of -.47 ($P < .05$). Cows that had been wintered on a ration lower in energy had less fat and smaller rib eyes (measured ultrasonically) and averaged slightly lower in muscling score. Only small average differences in ultrasonic fat depth occurred within age groups between two year old heifers, yearling cattle and calves. Two year old heifers had larger rib eyes than cows but were not appreciably fatter as measured ultrasonically.

These results should be considered preliminary since more refinement of instrumentation and technique is necessary to make this ultrasonic method a valid tool in selection and evaluation of cattle.

Microfilm $2.75; Xerox $5.40. 108 pages.

AGRICULTURE, FORESTRY AND WILDLIFE

THE CARBOHYDRATE RESERVES OF LOBLOLLY PINE (PINUS TAEDA L.) ROOTS IN RELATION TO EARLY SURVIVAL OF OUTPLANTED SEEDLINGS.

(L. C. Card No. Mic 61-1441)

Alvan Ray Gilmore, D.F.
Duke University, 1961

Supervisor: Paul J. Kramer

Experiments were conducted to determine if survival and root growth of loblolly pine seedlings were dependent upon the carbohydrates in the roots at the time of lifting from the nursery bed and transplanting into the field.

Part I of the study relates survival of transplanted seedlings to effects of (1) shading seedlings in the seedbed and (2) storage of seedlings after being lifted from the seedbed. Part II of the study pertains to the relationship of reserve root carbohydrates to subsequent root growth of transplanted seedlings.

In the first part, seedlings were subjected to shade in the nursery bed, stored in cold storage rooms, or in a heeling-in bed. Carbohydrate and nitrogen contents of roots, length of shoot, and diameter of stem at time of transplanting were investigated as to their relationship to survival. Shading and storage treatments lowered the carbohydrate reserves of roots and a correlation was found between survival of seedlings that had been shaded or stored and carbohydrate reserves of roots. This correlation between survival and food reserve was not demonstrated in groups of seedlings that had not been shaded or stored before being transplanted. No correlation was found between nitrogen content or carbohydrate-nitrogen ratio of roots, and seedling survival.

Length of shoot did not exert any influence upon seedling survival, whereas diameter of stem was negatively correlated with survival of seedlings that had not been shaded or stored. Average diameter of stem was larger in all groups of seedlings that died. This relationship between stem diameter and seedling survival, presumably is related to the area of transpiring surface in relation to the moisture-absorbing surface of the seedling.

In the second part, seedlings were transplanted into root growth chambers and subsequent root growth observed. No definite correlation was shown between root growth of transplanted seedlings and food reserves of roots. However, results from seedlings girdled at time of transplanting, indicate that before root growth can begin, the roots must receive an unknown stimulus from the leaves or buds.

Microfilm $2.75; Xerox $4.20. 80 pages.

A NUTRITIONAL STUDY OF SLASH PINE SEEDLINGS GROWN IN SAND CULTURE

(L. C. Card No. Mic 61-1446)

Charles Eugene McGee, D.F.
Duke University, 1960

Supervisor: C. W. Ralston

This study was initiated to determine the response of slash pine seedlings to varying supplies of nitrogen, phosphorus and potassium. Seedlings were grown in greenhouse cultures for four months under 30 nutrient supply regimes.

At the end of the growth period, seedlings were harvested, weighed, measured, and separated into shoot and root sections. The sections were oven-dried and stored until chemical analysis was completed. The seedling tops and roots were analyzed for nitrogen, phosphorus, and potassium content on a dry weight percent basis.

The seedling yield--nutrient supply relationship--was defined by regression analysis and the results presented in graphic form. The relation between seedling composition and nutrient supply is presented graphically on a mean value basis. The relation between seedling yield and needle composition also was described by regression analysis and the results presented in graphical form.

The following conclusions have been drawn from the results of the study:

1. Dry weight, fresh weight, and stem elongation are highly interrelated measures of growth. However, the relative importance of the elements, nitrogen, phosphorus and potassium vary in the production of different types of yield. Nitrogen is found to be the most influential in fresh weight yield while potassium exerts the most influence on dry weight yield and seedling elongation. The effect of phosphorus is very influential on fresh weight production, although the degree of influence is less than that of nitrogen.

2. Optimum yields in dry weight, fresh weight and elongation were observed at supply levels of 125 parts per million of elemental nitrogen, phosphorus and potassium. The calculated supply ranges for optimum dry weight production were indicated at supply levels of 100 to 200 parts per million for nitrogen, 125 parts per million plus for phosphorus, and 100 to 300 parts per million for potassium.

3. The shoot-root ratio of dry weight is controlled largely by the level of nitrogen supply. As the supply is increased a greater percentage of the total dry matter of the plant is found in the shoot.

4. The percentages of nitrogen, phosphorus, and potassium found in the shoot and root tissue are highly correlated with the supply of these elements. The percentage of nutrients present in the tissue increased with each additional increment of nutrient supply.

5. The ratio of mineral percentages present in the shoots and roots varied with each element. In all of the treatments the shoots contained a higher percentage of nitrogen than the roots. The shoot-root ratio was nearest unity when nitrogen was either scarce or over-abundant. Generally, a higher percentage of phosphorus was found in the roots than in the tops. Notable exceptions occurred when the nitrogen supply was high. For this condition, a higher percentage of phosphorus was found in the seedling tops. The roots also had a higher content of potassium except when the nitrogen and/or phosphorus supply was high.

6. Several possible interactions of one element of supply on the uptake of another element were noted. An increasing nitrogen supply was associated with a decreasing percentage of phosphorus in the roots. An increasing potassium supply was associated with an increasing supply of phosphorus in the roots.

7. Dry matter production was found to be related to needle composition. Optimum yields are predicted when the nitrogen content of the needles range from 2.5 to 3.5 percent of dry weight. Optimum growth occurs when potassium content is from 0.5 to 0.7 percent. Phosphorus was found to be limiting at foliar concentrations of less than 0.22 percent.

Microfilm $2.75; Xerox $4.80. 92 pages.

FUNDAMENTAL ASPECTS OF THE WOOD CUTTING PROCESS

(L. C. Card No. Mic 61-1762)

William Moore McKenzie, Ph.D.
University of Michigan, 1961

This research was based on the premise that the diverse wood machining processes have vital problems in common, and that the most basic of these concerns the action of a wedge-shaped cutter on a wooden work-piece, in the simplest possible cutting situation. The object was to investigate how far an analytical study of this simple situation might supply the principal information ultimately required for all machining processes, concerning the forces acting on the tool and the work, the nature of the chip, and the surface formed.

Since evidence concerning the effects of cutting speed on forces and surface formed was contradictory, cutting experiments were carried out using a lathe, at cutting speeds ranging from 0.5 in. to 28,000 ft. per min. The results showed a small linear effect of cutting speed on cutting forces, attributable to chip acceleration, and it was concluded that this factor need not be considered further in developing an analysis.

Because of the extreme anisotropy of wood, it was found necessary to investigate a situation at a particular grain angle, that in which both the cutter edge and velocity vector were perpendicular to the grain. Preliminary observations included cutting force determination and microscopic study of cutting action, and provided the basis for a classification of modes of chip formation to be accounted for analytically. An important feature revealed was an "indentation phase" involving deformation before incision, associated with the maximum amplitude of the recorded cutting forces. This appeared even with sharp cutters, and was attributed to the existence of a cutter edge radius of the same order as cell wall thickness. On the assumption that incision requires that fibres at a point on the curved edge profile be stressed to their ultimate strength in tension, models were developed to represent the cutting process. The principal models were based on the reactions of an elastically supported beam.

Despite certain limitations of these models, the results for forces and failure types derived from them showed some accord with reality, and are considered to be of practical value in predicting cutting forces and surface quality.

Similar models appear to be applicable to the other important cutting directions in which the cutter edge and cutting speed are orthogonal to the axes of symmetry of the wood, and hence the analysis appears to have limited but important generality.

Other results, with practical implications, suggest that lateral vibration and lubrication may, under certain conditions, modify the indentation phase and greatly improve surface quality. The beam models appeared to involve the more important variables acting, except perhaps shear properties. The models emphasize the importance of the ratio between the Young's moduli respectively perpendicular and parallel to the grain, and since this is very sensitive to moisture content, take into account the dominant influence of this factor on the chip formation process and resulting surface quality. Frictional properties are also indicated as being of general importance. It is concluded that fuller validation of these indications will require an empirical approach based on experimental stress analysis, aimed at determining the stresses in certain zones of interest in the vicinity of the cutting edge, defined in the present study. The models served to define certain areas of ignorance concerning the properties of wood, and several problems basic to further understanding the fundamental action of a cutting edge.

Microfilm $2.75; Xerox $7.60. 161 pages.

A BIOLOGICAL AND ECOLOGICAL STUDY OF THE IPS BEETLES ATTACKING JACK PINE IN CENTRAL WISCONSIN WITH A TENTATIVE CLASSIFICATION OF SUSCEPTIBLE TREES

(L. C. Card No. Mic 61-1552)

John Albright Schenk, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Daniel M. Benjamin

Bark beetles have been of primary concern in North America for over half a century. Yet, relatively little research has centered on the Ips species, responsible for the disruption of management plans and economic losses in the jack pine forests of the Lake States. Consequently, a three year study was conducted to obtain fundamental information on the biology and ecology of the Ips pini (Say) and other bark beetles indiginous to the region; to characterize jack pine's susceptibility to bark beetle attack; and to erect a susceptibility classification based on external tree characteristics.

The more important literature pertaining to bark beetle taxonomy, biology, ecology, host preference, and host susceptibility was reviewed. Artificially induced attacks in caged and exposed jack pine logs were established in the vicinity of Wisconsin Rapids, Wisconsin. Systematic examinations of bark beetle broods within the logs were conducted over a period of 60 days during 1957 and 1958. Natural infestations in standing trees also were studied.

Ips pini overwintered in the soil or litter as mature adults. Immature stages apparently succumbed to the cold winter temperatures common to the region. Spring flight normally occurred in late May following a period of a mean temperature of approximately 62° F. and about one week of little or no rainfall. A single male mated one to six females. Each female oviposited a maximum of four to five eggs per day, or 146 eggs during a life time of about 30 days. Head capsule measurements indicated three larval instars. A complete life cycle, including mating and oviposition to mature adult, required 33 to 35 days. Mature adults required an additional 6 to 11 days before emergence from the host logs. Mean air temperature for a completed generation was about 69° F. Excess precipitation and low minimum daily air temperature apparently prolong the duration of the developmental stages, probably through reduced feeding activity.

Inter-specific competition was severe. One cerambycid larva destroyed about 50 percent of a bark beetle brood in the egg and early instar larval stages, and substantially reduced the surface area available for bark beetle development. Intra-specific competition also reduced available food and shelter. Indiscriminate feeding by the callow and mature adults added to the mortality of the nearby eggs and young larvae. Thanasimus dubius (F.) was the most abundant predaceous species. An ant, Aphaenogaster tenesseensis (Mayr) was very abundant, and was observed feeding on injured adult bark beetles.

In uninfested trees, a highly significant decrease in moisture content of about 0.5 percent oven dry weight of increment cores existed for each percent decrease in crown length. No significant relationship existed between crown dominance class and moisture content. Bark beetle activity apparently destroyed the significant relationship in infested trees. Attacked trees possessed lower average moisture contents than in noninfested trees.

An explanation of the susceptibility of jack pine to bark beetle attack is proposed on the basis of the following: (1) Trees with initial high rates of oleoresin exudation tend to repel or resist attack; (2) Resin exudation pressures vary directly with the moisture content of the tree; (3) Trees with smaller crowns in relation to total height possess proportionately lower moisture contents; (4) Ips attack and development is normally more successful in small crowned trees.

Relative susceptibility of jack pine was estimated using the total crown volume as a criterion. The frequency of bark beetle attack was recorded within thirteen crown indices (crown index = percent of total height x fullness, expressed as a percent). Over 60 percent of the bark beetle infested trees fell into crown indices 17 through 25. These were grouped into a highly susceptible Class 25, and exhibited any of the following combinations of crown percent and crown fullness: 75 percent x 1/4 full; 25 percent x full; 25 percent x 3/4 full; 20 percent x full; 50 percent x 1/2 full; 33 percent x 3/4 full; and 33 percent x 1/2 full, in increasing order of susceptibility. Similarly, a resistant tree would possess a fully symmetrical crown comprising 33 to 50 percent or more of the tree's total height, and typed as a Class 50, or good Class 38 tree.

Microfilm $2.75; Xerox $6.80. 145 pages.

THE DESIGN OF HARVESTING SYSTEMS AND MACHINES FOR USE IN PULPWOOD STANDS OF THE TENNESSEE VALLEY AS DICTATED BY INTENSIVE FOREST MANAGEMENT

(L. C. Card No. Mic 61-1803)

Thomas Alexander Walbridge, Jr., Ph.D.
University of Michigan, 1961

The purpose of this study is three-fold: first, to evaluate present harvesting systems and machines now in use in the Tennessee Valley; second, to seek out those systems and machines already in use throughout other areas in the United States and Canada which show the greatest potential for increasing man-day production on intensively managed stands in the Tennessee Valley; and third, to evaluate the economic feasibility of future systems often advanced as the ultimate in mechanized harvesting.

The status of management, land ownership pattern, terrain and weather is discussed as to their effect on the manner in which the producer must operate in the Valley today. An analysis of time studies of 24 producers operating on 30 hardwood and pine cutting sites resulted in an accurate picture of the full-time producer; his methods of operation, costs of labor and machines, total costs of production, incentive as the entrepreneur, and average hourly earnings. Little change in present operating techniques now used by full-time producers in the Valley is predicted until the maturity of natural stands and plantations now established in the Valley. Adequate stumpage in concentrated volumes should provide increased opportunities to raise man-day productivity through mechanization.

An investigation was made of harvesting systems and

machines used in other areas of the United States and Canada, in terms of basic phases of harvesting. Several systems and machines appear feasible for present or future application to mature plantations and natural stands in the Tennessee Valley. Specifications and photographs of typical equipment are presented to furnish examples of the type and selection of harvesting equipment available on the market today.

The factors of capital, machines and labor and their proper balance with regard to the design of a harvesting system are discussed. Availability of capital may be the controlling factor in design of a harvesting system. Complete mechanization will require capital investments equal to many times the minimum. When such mechanization is indicated as necessary, administrative decisions other than capital requirements will be required.

The natural terrain classes of the Valley fit well with inherent terrain limitations of many harvesting machines and suggest a means of proper selection to attain maximum efficiency. Grouping of machines by their terrain limitations resulted in five basic systems which with various machine selections allowed the design of ten harvesting systems. Using total costs as a measure of validity of prescribing harvesting systems according to terrain classes, results indicated such small cost variations that no one system within terrain classes could be championed. But the validity of using terrain limitations of machines as a guiding factor in harvest system selection was demonstrated.

The discussion of future systems in plantation stands revealed that tree length logging as presently practiced in the piney flat woods is a promising system in the Tennessee Valley. Chipping in the woods, following debarking, is another system that has possible future application. The use of flexible conveyors for the transport of bolts or tree lengths, appears feasible under plantation conditions. Chip pipelines were ruled out as a future system of transport due to the tremendous concentration of stumpage required. The use of helicopters appears unlikely for future harvesting in the Valley.

Conclusions of this study are set out below:

1) Clear cut harvests of plantations and mature natural stands as assumed in many parts of this study, are still some years away and the need remains for continual probing and experimentation in equipment development and harvesting system design.

2) Continuing time study programs, using standardized techniques are needed and should be initiated by the pulpwood industry as rapidly as possible.

3) Initial design of new equipment, and modifications to old equipment, must come from the pulpwood industry for it is not the manufacturer's problem, but lies squarely with those who are daily concerned with the design of harvesting systems and machines.

Microfilm $3.80; Xerox $13.30. 293 pages.

AGRICULTURE, PLANT CULTURE

EARLY DEVELOPMENT OF CORN UNDER CONTROLLED GREENHOUSE CONDITIONS AS RELATED TO FIELD PERFORMANCE UNDER VARIOUS CULTURAL PRACTICES

(L. C. Card No. Mic 61-1518)

Shrawan Vithalrao Bokde, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Robert H. Andrew

In this investigation, early development of corn under certain controlled greenhouse conditions was studied with a view to interpreting field performance under various cultural practices.

In the field, measurements were taken on yield, number of ears per plot, average ear weight, stalk breakage and lodging on eight corn hybrids at four populations, three fertility levels and in two seasons. In the greenhouse, six of the hybrids used in the field were studied at four populations, three fertility levels and two diurnal temperature regimes. Total dry matter, root dry weight, shoot-root ratio, plant height and leaf area were measured at three growth stages.

Results are summarized as follows:

In the field, yields and ear weights (1) averaged considerably greater at the F_2 and F_3 fertility levels than at the F_1 level; (2) averaged higher in 1959 than for relatively drier 1958; and (3) were higher with hybrids V_5, V_4 and V_2 in 1958 and with hybrids V_7 and V_5 in 1959. Over both years, hybrids V_5 and V_4 produced higher yields and ear weights.

For yield and ear weight, hybrids showed a differential response to fertility level in 1958. For example, high yields and ear weights were obtained with hybrid V_5 at all levels of fertility. However, hybrid V_2 gave low yield at the F_1 fertility, but gave high yields at the F_2 and F_3 fertility levels. For yield, hybrids also showed a differential response to population in both seasons. In 1958, high yields were obtained with hybrid V_2 at the P_1 population (13,000 plants) but with hybrid V_5 at the P_2, P_3 and P_4 populations (16,000, 19,000 and 22,000 plants respectively).

Yield and average ear weight were highly correlated in 1958 and also over both years. As a yield component, ear number assumed relatively greater importance in 1959.

In the greenhouse, on a basis of degree-days, dry matter per plant at the warm temperature (66°F night - 76°F day) was nearly equal to that at the cool temperature (58°F night - 68°F day). Thus, approximately an equal number of degree-days (33.3 and 35.6) were required at warm and cool temperatures to produce 0.1 g. of total dry matter. On a basis of degree-days, root weight per plant was higher at the cool temperature (58°F - 68°F) than at the warm temperature (66°F - 76°F). Half again the number of degree-days (231.5 vs. 160.6) were required at the warm temperature as compared with the cool temperature to produce 0.1 g. of root dry matter.

Dry matter and root weight per plant usually were higher with hybrids V_5, V_4 and V_1 as compared with hybrids V_2, V_6 and V_7.

While shoot-root ratio did not vary for hybrids and population levels, it was significantly lower at the cool

temperature than at the warm temperature, primarily because of greater root growth at the cool temperature.

On a basis of degree-days, plant height and leaf area per plant were higher at the warm temperature than at the cool temperature. Plant height and leaf area usually were higher for hybrids V_7, V_5, V_4 and V_1 than for hybrids V_2 and V_6.

Associations between certain measurements of the greenhouse and field grown plants were observed. These correlations generally were higher at the warm temperature than those at the cool temperature.

Dry matter and root weight per plant gave high associations with field yield at the F_1 fertility level, and with field ear weight at all fertility levels. Leaf area usually gave high associations with field yield and ear weight at all fertility levels.

For the characters studied in this investigation, the hybrids V_1, V_4 and V_5 gave superior performance both in the field and in the greenhouse.

Microfilm $2.75; Xerox $6.40. 132 pages.

AVAILABILITY OF SOIL WATER TO PLANTS

(L. C. Card No. Mic 61-2257)

Owen Thomas Denmead, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Robert A. Shaw

The dynamic aspects of the availability of soil water were considered in relation to the flow of water in the transpiration stream. By analogy with the flow of heat into an infinitely long cylinder, the mathematical solution of the equation describing the flow of water through the soil to the plant root in the course of transpiration can be obtained. Considerations of the solution to the flow equation show that the actual transpiration rate at any soil moisture content (or at any soil suction) depends on the moisture properties of the soil (suction and capillary conductivity characteristics), the maximum diffusion pressure deficit which can be developed in the plant tissues and the potential transpiration rate.

Experiments with corn grown in large containers in the field showed that these theoretical predictions concerning the actual transpiration rate are qualitatively correct, except when potential transpiration rates are high. Then, it appeared that turgor-induced changes in the permeability of the plant to water movement might restrict transpiration much more than the theory predicts. The experiments showed that for moderate potential transpiration rates (3 to 4 mm. per day), the actual transpiration rate was very nearly equal to the potential rate until the average soil suction had increased to a value of 1 bar. As soil suction increased beyond 1 bar, the actual transpiration rate declined rapidly. When the potential transpiration rate was low (less than 2 mm. per day), the actual transpiration rate did not decrease until the average soil suction exceeded 5 bars; some transpiration still occurred when the average soil suction was 40 bars. When the potential transpiration rate was high (of the order of 6 mm. per day), the actual transpiration rate decreased rapidly when the average soil suction exceeded only 0.2 bar.

The dynamic theory of transpiration implies that there is an upper limit to the transpiration rate from a plant, determined by the maximum diffusion pressure deficit which can be developed in the plant tissues. Data from the experiments indicated that the maximum diffusion pressure deficit which can be developed in the corn plant is of the order of 100 bars and that the maximum transpiration rate possible for corn is in the vicinity of 6.6 mm. per day.

If one assumes that plants wilt when the diffusion pressure deficit in the plant exceeds a certain critical value, it can be shown that the wilting point is governed by dynamic factors, including the transpiration rate. The experiments indicated that the wilting point fluctuated from a soil moisture content close to the 15-bar percentage when the potential transpiration rate was less than 2 mm. per day to a soil moisture content not much less than field capacity when the potential transpiration rate exceeded 6 mm. per day.

The assimilation rate of corn plants appeared to be closely related to their transpiration rate. At soil moisture contents close to field capacity, the net assimilation rate appeared to be closely related to the potential transpiration rate. When soil moisture content decreased, the relative assimilation rate of the plants decreased in the same way as did their relative transpiration rate.

Microfilm $2.75; Xerox $6.20. 129 pages.

THE MEASUREMENT AND INHERITANCE OF RESISTANCE TO FRUIT CRACKING IN THE TOMATO

(L. C. Card No. Mic 61-1622)

Roger William Hepler, Ph.D.
University of Illinois, 1961

A vacuum-immersion method for testing resistance to fruit cracking in the tomato was developed. The screening method consisted of placing detached fruits in water, drawing a partial vacuum until air bubbles were no longer emitted from the stem end of the fruit, releasing the vacuum, and continuing immersion for a given length of time. Resistance was measured by the length of cracks induced.

Results of the variety tests using the vacuum-immersion method indicated that varieties known to be susceptible to cracking cracked to a greater extent than most varieties alleged to be resistant to cracking. There were some allegedly resistant varieties that appeared to be intermediate in resistance. Lines homozygous for the sticky peel (pe) character were free of cracks both in field and in vacuum-immersion tests. This type of resistance was either closely linked or pleiotropic to the pe locus. The types of cracking induced with vacuum-immersion were similar to the types of cracking occurring in field tests for any given variety.

The amount of cracking induced with the vaccum-immersion test appeared to be regulated by the degree of evacuation, length of time of immersion after evacuation, and temperature of the immersion water. The amount of cracking on most resistant and all susceptible varieties

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

increased as the severity of the test was increased, but a significant difference was maintained between the resistant and susceptible varieties in any given test.

Fruits could be sampled any time during a day, but testing had to be done within 12 hours of harvest. The same amount of cracking was induced on both shaded and exposed fruits within a variety. When crack-free fruits of resistant and susceptible varieties were tested, the greatest amount of cracking was induced on fruits within the maturity range of six days beginning at the time of coloring.

No differences were found within a variety when sampled at different times within a season. The amount of cracking induced on most varieties was not significantly different between two seasons.

Two resistant varieties (Accessions 284 and 266) were crossed to each of two susceptible varieties (Garden State and 1252-104). Lengths of radial and concentric cracks were measured on fruits of the parental, F_1, F_2, and backcross populations. Results of the genetic test indicated that heritable differences in crack resistance were present. Gene action that was additive, partially dominant, and dominant for susceptibility was indicated. The type of gene action depended upon the cross and the type of cracking being measured. Estimates of heritability depended upon the resistant parent in the cross. The heritability estimates were higher when Accession 284 was used as the resistant parent than when Accession 266 was the resistant parent, and the estimates were higher in all crosses for radial cracking than for concentric cracking. The estimates of the number of effective factors ranged from zero to five depending upon the type of cracking (radial or concentric) and the formula used in making the estimate. Microfilm $2.75; Xerox $4.60. 88 pages.

THE INFLUENCE OF SEEDING RATES ON BOTANICAL COMPOSITION AND YIELD OF FORAGE MIXTURES UNDER TWO DIFFERENT CUTTING TREATMENTS

(L. C. Card No. Mic 61-1952)

William Frederick Hueg, Jr., Ph.D.
Michigan State University, 1959

Major Professor: C. M. Harrison

In a greenhouse experiment, Alfalfa (Medicago sativa), Red Clover (T. pratense), Ladino clover (T. repens L) and Bromegrass (Bromus inermis) were planted at varying seeding rates in mixtures, and subjected to two and five cutting treatments. As the rate of seeding of the individual species was increased, the number of plants of that species and total plants in the mixture increased.

Under both cutting treatments the yield of the individual species in mixtures was not higher than the yield of the species seeded alone. In only four of the thirty-three mixtures that were cut twice, were total yields greater than alfalfa seeded alone, and eleven mixtures had total yields lower than red clover seeded alone. Total yields from mixtures with Ladino clover and bromegrass were greater than either species seeded alone.

The increased rate of individual species in the mixtures had less influence on total yield of tops and roots than the two different cutting treatments. Higher total yields of forage and roots were produced from the mixtures cut twice. Ladino clover and bromegrass were less affected by frequent cutting than red clover or alfalfa. Alfalfa yields decreased when the recovery period was of short duration, but the other species showed increased yields with successive cuttings.

The dependence of new growth on carbohydrate reserves was shown by the roots from those mixtures cut frequently. The vigor of alfalfa roots as seen in weight, length and diameter determinations, was reduced markedly by frequent cutting. Red clover and bromegrass roots were also retarded by frequent cutting but less than alfalfa. Ladino clover produced more vigorous roots and slightly higher root yields under frequent cutting.

In the mixtures for pasture, higher total yields were obtained at the higher rates of seeding, while the medium seeding rates produced the highest yields of hay. Mixtures of two compatible species gave as much or more yield than those mixtures with more than two species. The inclusion of Ladino clover to an alfalfa-bromegrass mixture for hay purposes did not add to the total yield in this experiment, and the rapid recovery attributed to Ladino under frequent cutting was overshadowed in mixtures cut for hay by competition from other species. When red clover was used in the mixtures, total yields were not increased and the yield of component species was less than when only two or three species were in the mixture.

Microfilm $2.75; Xerox $5.20. 103 pages.

BOLL ABSCISSION AND FIBER PROPERTIES IN UPLAND COTTON AS INFLUENCED BY NITROGEN, MOISTURE, AND GIBBERELLIC ACID TREATMENTS.

(L. C. Card No. Mic 61-1896)

Rex Weldon Millhollon, Ph.D.
University of Arizona, 1961

Moisture, nitrogen, and gibberellic acid variables were used to form basic experiments for a detailed study of boll abscission in cotton. The effects of these treatments on fiber properties and other plant characteristics were also studied. Experiments were conducted to study the relationships between pollination and boll abscission and the role of auxin in the abscission process.

The experiments for this study were conducted over a two-year period during 1959 and 1960. All field experiments were conducted at the University of Arizona's Cotton Research Center, Phoenix, Arizona.

Nitrate-nitrogen concentrations of petioles (taken to be indicative of the nitrogen status of the cotton plant) decreased as the season advanced at all moisture levels regardless of nitrogen treatments. Nitrogen fertilization was associated with a high nitrate-nitrogen concentration in the plant early in the season. This favored vegetative growth but not boll set. As the boll load became greater, the nitrate level in the plant decreased and the number of bolls that set at weekly intervals increased.

The effects of different moisture levels on boll set were not clear. There was some indication that boll set was

immediately increased by an irrigation at the lowest moisture level. However, since the uptake of nitrogen was also increased by an irrigation at this level, moisture effects may have been secondary.

When gibberellic acid (GA) was sprayed on whole plants at the rate of 18 grams of GA in 48 gallons of water per acre, percentage boll abscission was decreased and the number of bolls that set per plant was increased by approximately 19 per cent. Increased boll set was apparently offset by decreased boll size, and yields were not increased.

Treatment of individual flowers with 100 ppm GA at daily intervals resulted in smaller plants with a much heavier boll load than the control. Boll size was extremely reduced by such treatments. Chemical analyses of leaves and petioles showed that nitrogen was evidently limiting for normal growth of bolls.

Plants grown under the nitrogen deficiency imposed were apparently able to adjust growth and fruiting so that seed and fiber properties were not greatly affected. A low moisture level had an adverse effect on the number of seeds per boll, boll size, and fiber fineness. There was a tendency for fiber strength to be increased by this treatment. The increased boll load and increased growth that resulted from GA treatments also reduced the size of seed and the quality of fiber produced.

Histological studies showed that most ovules of both normal and abscissed bolls contained embryos, indicating that boll abscission was not ordinarily caused by nonviable pollen.

The process of fertilization appeared to be necessary for boll growth following a 72-hour period after anthesis. Growth of bolls that abscissed was not stimulated by fertilization.

Auxin concentrations of normal bolls of different ages in hours after anthesis were highest at 48 hours, dropped sharply at 72 hours, and started to increase again at 96 hours. The auxin concentration for fertilized bolls that abscissed at 96 hours after anthesis was lower than the auxin concentration for normal bolls at 72 hours after anthesis.

The theory was advanced that boll abscission is a result of a nutrient deficiency, especially nitrogen, in the plant. Such a deficiency ultimately affects the auxin concentration of bolls which is normally low at approximately 72 hours after anthesis. Thus, those bolls that are in an unfavorable position to receive adequate nutrients are abscissed as a direct result of the lowering of the auxin concentration below a critical level.

Microfilm $2.75; Xerox $5.80. 117 pages.

MODIFICATION OF FLORAL MORPHOGENESIS IN THE TOMATO (LYCOPERSICUM ESCULENTUM) WITH N-m-TOLYLPHTHALAMIC ACID

(L. C. Card No. Mic 61-1960)

Jane Yupei Shen, Ph.D.
Michigan State University, 1959

Certain aspects of floral morphogenesis in the tomato plant as influenced by treatment with low temperature (55°F) and N-m-tolylphthalamic acid were pursued. Apical meristems were collected daily for histological examination from the time of seedling emergence until 15 days after the 2-3 leaf stage. At cotyledon expansion only the two plumule leaves had been initiated. Vegetative-reproductive transition came two days earlier (8th day after germination) in the cold-treated (55°F) plants than in the non-treated (72°F). Cold-treated plants also had fewer leaves (nodes) subtending the reproductive primordium than the non-treated. In the N-m-tolylphthalamic acid treated seedlings, the sympodial bud subjacent to the inflorescence was retarded in development, consequently giving the inflorescence a longer period of apical dominance, and resulting in polychotomous branching of the inflorescence. Treatment with N-m-tolylphthalamic acid prolonged juvenility of the sympodial bud, while at the same time projected a direct induction of greater flower numbers in the inflorescence.

A comparison of several methods of application over a wide range of concentrations suggested that the primary site of action of N-m-tolylphthalamic acid was the terminal meristem. Measureable increases in flower numbers were obtained with as little as 0.3 microgram applied directly to the apical meristem. The optimum time for treatment to obtain polychotomy and greater numbers of flowers in the first inflorescence was at the 2-3 leaf stage of seedling development when the transition from vegetative to reproductive development occurred in the apical meristem.

The translocation pattern of C-14 N-m-tolylphthalamic acid in the tomato plant revealed that more than 50 percent of the foliar absorbed chemical was not recovered 24 hours after treatment. This observation and the temporary effect of the chemical on flower formation suggest that N-m-tolylphthalamic acid is extremely labile in the biological system of the intact tomato plant. However, the recovered chemical was in the form of intact N-m-tolylphthalamic acid as substantiated through paper chromatography of acetone extracts of treated leaves, which gave Rf values typical of N-m-tolylphthalamic acid. Autoradiograms of intact plants following treatment of one of the plumule leaves with C-14 labeled N-m-tolylphthalamic acid indicated a high concentration of radio-activity in the apical meristem.

Possible breakdown products of N-m-tolylphthalamic acid were not active in inducing polychotomous inflorescences in the tomato. An intact molecule of the chemical was required. Avena straight-growth bioassays and parthenocarpic development of tomato ovaries suggested that N-m-tolylphthalamic acid possesses "auxin-like" activity.

Microfilm $2.75; Xerox $6.20. 129 pages.

THE PHYSIOLOGICAL ROLE OF BORON IN THE ROOTING OF HYPOCOTYLS OF PHASEOLUS VULGARIS L.

(L. C. Card No. Mic 61-970)

Conrad John Weiser, Ph.D.
Oregon State College, 1961

Major Professor: Lawrence T. Blaney

Studies were conducted to determine why boron stimulated the rooting of bean hypocotyls. Four hypotheses, each based on postulated roles for boron in intact plants, were proposed and examined experimentally. The four hypotheses were: 1) boron affected auxin metabolism, 2) boron enhanced sugar translocation from the leaf to hypocotyl, 3) boron affected cell wall metabolism, and 4) boron affected oxidative processes.

On the basis of experimental evidence the first three hypotheses were rejected. The first hypothesis was rejected because rooting trials showed no similarity between the effects of boron and auxin. The second was rejected because studies comparing the translocation of U-C^{14}-sucrose, which had been applied to leaves of water-, boron-, and aluminum-rooted cuttings, with C^{14}-photosynthate, fixed by leaves on similarly rooted cuttings, showed that boron enhanced foliar uptake of sugar and not sugar translocation. Aluminum, which does not enhance rooting, was even more effective than boron in facilitating the foliar uptake of sucrose. Chromatography and a gradient elution study of the water soluble fraction of the 80 per cent ethanol Sohxlet extract from the $C^{14}O_2$ fixation experiment revealed relatively large amounts of citric and isocitric acid in the leaves of water and aluminum-rooted cuttings and only a trace in the leaves of the boron-rooted cutting. It is proposed that this may be due to the movement of the acids out of the leaves into the hypocotyl of the boron-rooted cutting. The third hypothesis was rejected when rooting studies revealed that phenylboric acid, which has more inhibitory influence on cell wall "crystallization" than boric acid, was found to be a less effective rooting agent. The fourth hypothesis, which proposed that the boron rooting effects resulted from an effect of boron on oxidative processes, was accepted because rooting studies showed that the oxidizing agent hydrogen peroxide, or aeration, had the same effects as boron on rooting. In view of the above mentioned differences in the distribution of acids in cuttings from different rooting treatments, it was suggested that the oxidative, root stimulating mechanism involves some phase of the acid metabolism of the cuttings, perhaps boron facilitated movement of oxygen-rich citric and isocitric acids from the leaves to the immersed hypocotyls which were oxygen-deficient. A partially oxidized substrate, such as an acid, could be utilized more readily in an oxygen-deficient environment than a sugar.

Preliminary studies revealed that 10^{-5}M boric acid gave near optimum rooting. Cuttings in water rooted only near the surface of the solution probably due to lower oxygen tensions in this region, while cuttings in boric acid rooted along the entire length of the hypocotyl. Cuttings in boric acid rooted sooner and had more and longer roots than those in water but the number of root initials was nearly the same in both cases, indicating that boron stimulated root growth and not root initiation. Shading of the rooting zone did not change the boron response. Several bean cultivars responded similarly to boric acid or other chemical forms of boron. The elements strontium, aluminum, and germanium, with complexing properties similar to boron, had no stimulatory effect on rooting. Boron did not affect the respiration of bean hypocotyl sections. Microfilm $2.75; Xerox $6.00. 121 pages.

EXPLORATORY STUDIES OF APPLE SCALD AT THE ENZYME LEVEL

(L. C. Card No. Mic 61-1438)

Lawrence Yoneo Yatsu, Ph.D.
Cornell University, 1960

Diphenylamine (DPA) has been found to be highly effective in the control of scald, a physiological disease of apples. The purpose of this thesis was to investigate the biochemistry of the prophylactic effect of DPA.

Because of the paucity of information concerning the respiratory mechanism of the apple fruit at the enzyme level, an exploratory study was conducted on the nature of apple fruit respiration. These studies were based on the current notion that the respiratory mechanism is intimately associated with minute organelles within the cytoplasm, known as mitochondria.

Mitochondria were identified in the cytoplasm of the parenchyma cells of the R. I. Greening apple fruit. They were identified by the use of the vital stain, Janus green B, and also by the use of hematoxylin on permanent slides. The mitochondria were also seen in the protoplasm of the intact, living apple fruit cell during cyclosis. They were observed under the phase-contrast microscope.

The following enzymes were shown to be identified with the mitochondrial preparations obtained from the apple fruit: 1) cytochrome oxidase, 2) the succinoxidase system, 3) the malic acid oxidase system, 4) the glutamic acid oxidation system and 5) oxalacetic-glutamic acid transaminase.

The respiratory activity of the isolated mitochondrial preparation was shown to be able to account quantitatively for the respiration of the intact fruit. The potential to mediate respiration via the tricarboxylic acid cycle was demonstrated to be present in the apple fruit from full-bloom until senescence.

Evidence was presented to show that the apple fruit mitochondria are able to conduct oxidative phosphorylation. There was an indication that the fruit loses this ability later in its life.

The apple fruit was found to contain a relatively high amount of malic dehydrogenase in the soluble form.

DPA did not inhibit the apple fruit cytochrome oxidase appreciably, although there was evidence that DPA elicited slightly more inhibition of cytochrome oxidase later in the life of the fruit.

DPA was able to act as an uncoupler of oxidative phosphorylation.

DPA inhibited the succinoxidase system of the apple fruit mitochondrial preparation. It also inhibited the succinoxidase system of cauliflower, rat liver, guinea pig liver and chick liver mitochondrial preparations.

A preliminary examination was conducted to determine

the effect of DPA on the titratable acid content and soluble amino acid composition of R. I. Greening apple skin. These cursory tests indicated that the titratable acid was slightly higher during the early part of the storage season in DPA treated skins than skins from the controls. There were several changes wrought in the amino acid composition by the DPA treatment. The most notable was the presence of asparagine, glutamic acid and alanine in higher concentrations early in the storage season on DPA treated fruit skins than on the controls. Pipecolic acid, which was not present in the skin extracts ordinarily, was observed in both the DPA treated and control fruit skin extracts very late in the storage season.

DPA was shown to enhance the ability of the apple fruit skin tissue to synthesize anthocyanins under the influence of light in the cold storage room. Tissue from DPA treated fruit maintained the ability to synthesize pigments for a longer period than skin from non-treated fruit.

Apple skin tissue was shown to be able to fix carbon dioxide non-photosynthetically. The distribution of radioactive carbon was investigated. The highest activity was found in the organic acids and the least in the neutral fraction. In contrast to the observations of others, skin tissue from senescent R. I. Greening apples did not seem to fix C^{14} into aspartic acid. Very little labelling went into glutamic acid. The highest amount of labelling for the amino acids occurred in alanine.

Although the potential to mediate the respiratory activity via the tricarboxylic acid cycle and the cytochrome system was demonstrated throughout the ontogeny of the apple fruit, the author put forth an argument in which he presents reasons for believing that the apple fruit changes its metabolic system during senescence.

Microfilm $2.75; Xerox $7.60. 165 pages.

AGRICULTURE, PLANT PATHOLOGY

THE RELATION OF ENVIRONMENTAL FACTORS TO DEVELOPMENT OF THE POINSETTIA ROOT ROT COMPLEX

(L. C. Card No. Mic 61-1435)

Durward Franklin Bateman, Ph.D.
Cornell University, 1960

The root rots of poinsettia (Euphorbia pulcherrima Wild.) caused by Thielaviopsis basicola (Berk. and Br.) Ferr., Rhizoctonia solani Kuhn, and Pythium ultimum Trow may occur individually or as a complex. Control of these diseases has posed many difficult problems since the 3 pathogens involved respond differently to fungicides and changes in environment. The present work was aimed at an elucidation of the influence of temperature, moisture, and pH upon growth of the pathogens, growth of the host, and development of the diseases and disease complexes, and to determine the major interactions between environmental factors and pathogens in relation to disease development.

The effects of individual environmental factors upon growth of the pathogens, growth of poinsettia, and development of the individual diseases were first determined, then all factors were combined in a factorial arrangement to determine the interactions between environment and pathogens upon development of individual diseases and disease complexes.

When T. basicola, R. solani, and P. ultimum were grown on Potato-Dextrose agar (PDA), T. basicola grew best at 21°C and both R. solani and P. ultimum produced maximum growth between 28 and 30°C. A soil temperature of 26°C was most favorable for poinsettia growth. Both Thielaviopsis and Pythium root rots were more severe at temperatures between 18 and 23°C, while Rhizoctonia root rot was most severe at temperatures above 26°C.

Soil moistures between 30 and 87% Moisture Holding Capacity (MHC) had a significant effect upon development of each of the diseases. Rhizoctonia root rot was most severe in soil with a moisture content between 33 and 45% MHC, and this disease was almost eliminated in soil with a moisture content above 80% MHC. Both Thielaviopsis and Pythium root rots were significantly favored by high soil moistures, but Pythium root rot was inhibited more in drier soil (below 50% MHC) than Thielaviopsis root rot.

Thielaviopsis basicola grew best on PDA or Potato-Dextrose broth (PDB) between pH 4.7 and 5.1, and R. solani produced maximum growth near pH 6.0. The growth response obtained with P. ultimum with PDA or PDB at various pH levels was variable. The optimum pH for growth appeared to depend to a large extent upon aeration of the media, whether or not liquid or solid media were employed, and upon length of the experimental period, but maximum growth generally occurred between pH 4.2 and 7.5. Poinsettia growth was not markedly influenced by soil pH in the range from pH 4.5 through 7.5, but there was a tendency for better growth on the acid side of this range.

Thielaviopsis root rot was inhibited considerably in soil of pH 5.6 or below, but in neutral and alkaline soil this disease caused severe damage. Pythium root rot development was similar to Thielaviopsis root rot development with respect to pH, but the amount of disease produced in neutral and alkaline soil was not as great as that caused by Thielaviopsis. Soil pH did not have a marked effect upon Rhizoctonia root rot development and its inhibitory or stimulatory influences upon disease development were not considered important.

Soil temperature, pH, and moisture were incorporated using 3 levels of each factor along with all possible combinations of pathogens in a $3^3 \times 2^3$ factorial arrangement to determine the combination of environmental factors which would result in minimum disease development regardless of the pathogen or pathogens present.

From both the studies in which individual environmental factors and pathogens were studied and the experiment in which the factorial combinations of environmental factors and pathogens were employed, similar conclusions were drawn. Low soil pH (below pH 5.6) reduced both Thielaviopsis and Pythium root rot severity even in the presence of low temperatures and high soil moistures, low soil temperature (21°C and below) limited Rhizoctonia root rot development regardless of the levels of other factors, and low soil moistures (45 to 33% MHC) markedly reduced damage caused by Thielaviopsis and Pythium. Pythium root rot was reduced in the presence of low soil moisture regardless of the levels of other environmental factors employed. Of the 216 combinations of environmental factors

and pathogens investigated, a combination of low soil pH (pH 4.5 to 5.6), low soil moisture (below 45% MHC), and low soil temperature (below 21°C) resulted in minimum disease, regardless of the pathogen or pathogens present.

Microfilm $2.75; Xerox $7.40. 158 pages.

STUDIES OF HOST AND PATHOGEN IN RELATION TO THE INFECTION PROCESS OF THE DUTCH ELM DISEASE, CAUSED BY CERATOCYSTIS ULMI (BUISM.) C. MOREAU.

(L. C. Card No. Mic 61-15)

Guillemond Benoit Ouellette, Ph.D.
Cornell University, 1960

Pronounced morphological variation of the fungus was observed when grown on artificial media containing different sources of carbon and phenolic compounds, as well as on host extracts. For example, with filter paper, which the fungus degraded, spores and hyphae were smaller than in the standard media employed, while in media containing tannic acid or bark extracts spores were larger and almost spherical in shape. With bark extracts, the fungus grew into numerous small colonies, some spores forming clusters and taking a brown coloration.

Histological studies of samples (collected over a period of 5 years) from trees inoculated naturally, artificially, and with caged beetles, showed that the pathogen grew abundantly in the spring in all xylem tissues. These were invaded by small hyphae developing from small spores and growing through pits or directly through cell walls. Small spores, often less than 0.5 micron in diameter and found to be produced exo- or endogenously, developed rapidly in early stages of infection. As infection developed, these spores simultaneously swelled very slowly and took a brown coloration. Part of the discoloration, that was visible sometimes on the second day following inoculation, was thus attributable to brown colored spores and hyphae, the degree of discoloration being proportional to the amount of growth of the fungus. Hyaline spores and hyphae disintegrated, thus liberating small spores (microendospores). The collapsed walls of these fungal cells gave rise to networks often giving the impression of tyloses.

The fungus was observed to precede discoloration, sometimes spreading into newly differentiated tissues and some tissues of preceding growth rings (in some cases to the pith of smaller branches) without subsequently causing appreciable discoloration. The fungus even invaded cambium, phloem and periderm tissues of some samples in the same manner. In periderm tissues, numerous brown spores of different sizes were observed giving rise to very dark spores (single or in clusters) containing endospores. In inoculated petioles and terminal shoots, although little growth occurred in vessels, the fungus invaded cortical and epidermal tissues, sometimes producing spores on the outside.

Cell walls, especially those of vessels and ray cells, were altered. At the time of wilting, particles, probably arising from disintegrating cell walls including tyloses, together with contents of hyphal cells and of cells adjoining vessels were intermixed with spores and hyphae plugging almost completely vessels of branches.

In late summer inoculations, growth of the fungus was limited to vessels and adjoining cells, was less profuse than in spring inoculations, and was similar to that in culture.

Development of the fungus in root tissues was essentially similar to that in stem and branches.

In several samples the fungus had crossed in branches from one growth ring to the following, which it had invaded quickly.

With beetle inoculations, penetration of the fungus was through injured vessels, but sometimes through other tissues, and it was found that the type of feeding was more important than the depth of the wound for successful inoculations. Dessication and other pre-feeding activities of the beetles appeared to reduce significantly the amount of inoculum these carry.

Stages of the development of the fungus are discussed. Probable causes of wilt in the Dutch elm disease are postulated, and possible factors related to the apparent physiological resistance on the part of the tree are suggested.

Microfilm $2.75; Xerox $6.20. 129 pages.

AGRICULTURE, SOIL SCIENCE

MINERALOGICAL, CHEMICAL, AND FERTILITY RELATIONSHIPS OF FIVE OREGON COASTAL SOILS.

(L. C. Card No. Mic 61-958)

Everett Arthur Jenne, Ph.D.
Oregon State College, 1961

Major Professor: Moyle E. Harward

The mineralogy of five coastal soils was investigated. The soils studied were members of the Astoria, Nehalem, Tillamook, Winema, and Clatsop soil series. After organic matter and iron oxide removal, profile samples were separated into sand; coarse and fine silt; coarse, medium, and fine clay fractions.

Feldspars and quartz were identified in the sand and silt fractions of all of the soils studied. The Nehalem soil was unusual in that montmorillonite was the only layer silicate identified. In addition to montmorillonite, traces of kaolinite were found in the Tillamook soil. The Winema soil also contained montmorillonite as the dominant layer silicate, although in this soil it was interstratified with illite. Heat treatments indicated the presence of a montmorillonite intergrade. Kaolinite was also identified in this soil. In the Clatsop soil montmorillonite, kaolinite, and illite were identified. The Astoria soil contained the most complex suite of minerals of any of these soils, with montmorillonite, kaolinite, chlorite, and illite being identified. There was a considerable degree of interstratification of montmorillonite and illite. A considerable portion of the montmorillonite was an intergrade. The presence of amorphous material and/or a low degree of crystalinity was apparent in the fine clay fraction.

Delta cation exchange capacity measurements, sodium hydroxide solubility weight losses, and differential thermal analyses established the presence of amorphous material of an aluminosilicate nature in each of these soils. The quantity of amorphous material determined by the sodium hydroxide treatment and by the delta cation exchange capacity method varied considerably.

The response of the clover-grass forage to potassium fertilization on the Astoria soil was very marked while the

response to lime was not. The yield response of the Tillamook soil, which has a low productivity in the natural state, showed a significant response the first year. The first cutting of the second year showed a significant response to both potassium and phosphorus as well as to lime. The forage on the Nehalem soil showed a significant response to potassium.

The response to lime on both the Tillamook and Astoria soils appeared to be largely due to an increase in nitrate production.

In both the Tillamook and Astoria soils the relatively high concentration of Ca+Mg in equilibrated water extracts was shown to be due to the presence of amorphous material. The Astoria soil contained an appreciable amount of illite but showed the greatest response to potassium, whereas, the Nehalem soil had the highest potassium status but no 10 Å mineral was identified.

Microfilm $2.75; Xerox $6.20. 130 pages.

THE INFLUENCE OF SEVERAL PHYSICAL SOIL FACTORS ON THE DEVELOPMENT AND ACTIVITY OF PLANT ROOTS

(L. C. Card No. Mic 61-1959)

Thomas Walter Scott, Ph.D.
Michigan State University, 1959

Major Professor: A. E. Erickson

Investigations were conducted to study the influence of several physical soil factors on the development and activity of plant roots.

Preliminary studies involved the consideration of a non-radioactive tracer to study root activity. Also, preliminary work was done with a radioactive tracer to study rooting patterns of crops under field conditions.

Absorption of non-radioactive Rb from different soil depths by corn was compared with absorption of p32 placed at similar depths in the soil. It was found that the pattern of absorption of the two tracers was quite similar for various stages of corn growth.

Preliminary work was done with radioactive tracers in field studies involving sugar beet and corn root systems. Patterns of root growth and root activity were established at various ages of growth of the plants. Actual corn root weights sampled from positions in the soil similar to where p32 had been placed compared favorably with amounts of labeled phosphorus absorbed.

A greenhouse study was conducted to determine the effect of compaction on the vertical growth of roots. Absorption of p32 indicated that bulk densities up to 1.46 in a Sims clay loam did not restrict root growth.

Compacted subsurface layers with a bulk density of 1.95 (in greenhouse containers) restricted the penetration of sugar beet and tomato roots but did not stop penetration by alfalfa tap roots. When peroxide, as a source of oxygen, was mixed with the compacted layers, sugar beet roots penetrated the zone of compaction. Fibrous root development on alfalfa tap roots was increased significantly because of peroxide treatment.

Differences in corn root patterns as affected by tillage methods on a Kalamazoo soil were established using tracer techniques. Eighteen inch disc plowing caused considerable increase in root activity at 12 and 18 inch depths. Corn yields were also increased substantially on plots which had received 18 inch disc plowing.

Microfilm $2.75; Xerox $5.00. 98 pages.

ANTHROPOLOGY

AN ANTHROPOLOGICAL APPROACH TO ADMINISTRATIVE CHANGE: THE INTRODUCTION OF A GUIDANCE PROGRAM IN A HIGH SCHOOL.

(L. C. Card No. Mic 60-5080)

Mark S. Atwood, Ph.D.
Columbia University, 1960

Problems. This thesis dealt with two problems. The first was to see if the theory and methods of the two social anthropologists, Arensberg and Chapple, could be used to interpret the consequences of an administrative change in a school. If their approach could be used, it would also make the case comparable with other studies of social organization because of the method of description. The problem to be so examined was why a high-school faculty were divided in their opinions and behavior toward a recently introduced guidance program. The majority of the older faculty were unfavorable, using its services as little as possible. The majority of the young, new faculty were favorable, using it whenever needed.

Data Collection. A sample of 45 people out of 111, 30 old and 15 new faculty, were interviewed and observed during a year in a large, Northeastern city high school. The interviews were semi-directed to enable people to talk about what was most on their minds and to build up a picture of their lives in the school.

Data Analysis. The opinions and behavior of the faculty were treated as interdependent parts of a social-cultural system tending toward equilibrium. The opinions and behavior were placed in their social-cultural context and changes in the whole studied over time. A change in them was considered an "emergent" from prior changes in the equilibrium. The opinions expressed were reduced to the tone they implied of liking or disliking the subject of their comment. The social situation of the school was reduced to the patterns of interaction among the faculty, described operationally: who interacted, in what order, how frequently, how regularly, how free to respond to the action of another, how many people in the event. These procedures freed the data from the limits of their particular content.

Findings. The unfavorable opinions toward the guidance program were only in part related to the disturbed equilibrium resulting from its introduction. The equilibrium was already disturbed by changes occurring before the program began and continuing during its development. The program intensified these other changes and the resulting disequilibrium. The unfavorable opinions were also related to the violation by the program of several major values held by the faculty. These violations served not only to legitimize the faculty's criticism of the program, but also served as the vehicle for expressing the irritations aroused in them by the other changes in the system.

The minority of older faculty were favorable because additional changes stabilized their interaction patterns. The deviant new faculty, undergoing rapid, continuing change, were prevented from developing stable patterns.

Thus the equilibrium hypothesis was confirmed with one important modification. Teachers were disturbed when changes disrupted their pattern of interaction and prevented it from stabilizing. But changes in overt activities alone did not necessarily imply changes in interaction. Unless they did, they were not followed by unfavorable opinions. The major interaction changes in this case were: decreasing frequency of teachers' initiating action and initiating action successfully; increasing frequency of having to respond to the initiations of others; and changes in their identity which symbolized decreasing social rank.

The theory thus made the difference in opinions understandable and explained as well the deviations from the pattern. The operational methods enabled the findings to be stated in common terms for comparison and future generalization.

Microfilm $4.95; Xerox $17.55. 387 pages.

THE CHANGING STATUS AND CULTURAL IDENTITY OF WESTERN AUSTRALIAN ABORIGINES. A FIELD STUDY OF ABORIGINES IN THE MURCHISON DISTRICT, WESTERN AUSTRALIA, 1955-1957.

(L. C. Card No. Mic 61-857)

Ruth Annette Fink, Ph.D.
Columbia University, 1960

Two of the consequences of European settlement in Western Australia have been the rapid disintegration of Aboriginal society, and the subordination of the Aborigines to the status of a coloured minority. One can document the process by which this gradual subordination took place in Western Australia, as Aborigines became absorbed into the growing pastoral industry. Their declining social status has led to considerable prejudice against them, and to a system of stereotypes about Aboriginal groups which are shared by a large part of the white community. The protective policies adopted towards Aborigines have fostered a differing set of norms for Aborigines and Whites, and have continued to handicap those who remain legally "natives" though they no longer share in a predominantly Aboriginal tradition. The protective legislation has helped to perpetuate their minority status.

In adjusting to the social barriers erected against them by the white community, part-Aborigines have developed distinctive communities and modes of living, which are partly an adjustment to their subordinate social situation. One such community was studied by a variety of anthropological field techniques. It was located in the Murchison District of Western Australia, where the Aboriginal peoples had originally belonged to the broad cultural grouping known as "Western Desert Culture."

The introduction of sheep into the area and the establishment of large pastoral stations forced the Aborigines to abandon their hunting and gathering economy. There was a gradual transition from being tribal Aborigines to becoming rural employees in the pastoral industry with a modified version of their traditional culture. Since the second World War a decline in traditional interests has been noted, with a preference for English rather than Aboriginal languages and a neglect of the traditional ceremonies which had been a yearly feature of station life. This decline coincided with (1) The death of older traditional leaders; (2) The introduction of wages which gave greater independence and freedom of movement to Aboriginal station hands; (3) The increasing attraction of town life and the spending of more money and leisure time in towns.

The paternalistic outlook of the pastoralists had fostered a dichotomy between White and Aboriginal standards, which was based upon the fact that the two groups would play different roles, with the whites always in a dominant position and the Aborigines always subordinate. Aborigines were not expected to provide for themselves or to have similar social aspirations to white people. The effective working of the station system depended upon this differentiation between the two groups.

Part-Aboriginal groups in the Murchison still retain a considerable measure of cohesion and natives regard themselves as different from white people even though their way of life is no longer based upon a clearly defined Aboriginal tradition. The decline in ceremonies, language and other distinguishing characteristics has not weakened the links between the members of the Aboriginal community, for their cultural identity now rests upon their physical appearance, which marks them out as of Aboriginal descent and symbolizes their low socio-economic status. It also rests upon their sharing of a common way of life as defined by the camp conditions and their participation in typical camp activities such as gambling. Some difference was found between the groups of Part-Aborigines near the towns and those who live and work entirely on sheep stations. The station natives have remained traditionally oriented for a longer period and had a more positive image of their own groups than the town dwellers who had completely rejected their Aboriginal heritage but found themselves still unable to assimilate into the white community. These people possessed a negative image of their own groups and tended to base part of their identity upon an opposition to White values, especially the values of the Australian Middle class as these are set forth in Native administration policies.

In view of these findings it was suggested that a reappraisal of the meaning of assimilation, as defined under present policies is needed. Native Administrations have not given sufficient recognition to the distinctive sense of identity that exists among Aboriginal groups, in their efforts to encourage individuals to assimilate by leaving their groups and abandoning their Aboriginal identity. In the future administrative policies need to recognize the reality

of distinctive Aboriginal groups, and to use these as a possible avenue for community development programs, since at present the policy of assimilation seems aimed at destroying the existing groups by encouraging and giving special privileges to the individuals who are prepared to disassociate themselves from the Aboriginal community. A few experiments in community development have begun, in each case with the full consent and active participation of Aboriginal members, and these seem to point the way for further attempts in this direction.

Microfilm $4.10; Xerox $14.40. 319 pages.

SOCIAL AND ECONOMIC MOBILITY IN A LOW-CASTE NORTH INDIAN COMMUNITY

(L. C. Card No. Mic 61-726)

William Leal Rowe, Ph.D.
Cornell University, 1960

The social and economic mobility of a community of 303 Noniyas living in Baranpur hamlet of Village Senapur, District Jaunpur in the state of Uttar Pradesh, India was studied in terms of the changes related to the caste's attempt to raise itself within the social and economic hierarchy of the multi-caste village of Senapur during the past 60 years.

Noniyas are currently an agricultural and earth-working caste but were formerly salt and saltpeter workers. A socio-political movement beginning in 1898 in North India urged Noniyas to assume the status of Chauhan Rajputs, claiming that the present Noniyas are descendants of Chauhans who migrated east from Delhi after their defeat by Muslim forces in the 16th century. The Chauhan movement has served to reduce status differentials for those prosperous Noniyas of low ritual and social status (by virtue of their Noniya Sudra affiliation) who held a high economic status acquired through earth work contracting or through acquisition of land. The movement is analyzed through its acceptance by the Baranpur Noniyas in the late nineteen thirties and through the effects it has had on inter-caste relations in the multi-caste village.

As is typical of North Indian castes, the Noniya are endogamous, patrilocal, and patrilineal. The village community forms an exogamous unit, relating the Baranpur Noniyas to 86 different Noniya communities at an average distance of 12 miles from Baranpur. This group of villages forms a marriage network which acts as a functional unit and has importance in social, political, economic, and religious areas of Noniya life. Because of the recent abolition of landlordism many of the ties between Noniyas and the dominant landlord caste of Senapur are decreasing in strength. The marriage network is assuming increasing importance in lieu of the former closer integration of the caste community in the multi-caste village. The Chauhan movement reached the Baranpur Noniyas through affinal connections in the network, a unit of social organization through which various changes have been introduced.

The mobility striving of the Noniyas has strengthened family organization. The economic necessity for a large number of men to work outside the village causes heavy agricultural labor demands on the household economic unit and consequently, a tighter, more closely integrated family unit. This is reflected in the fact that 174 of the 303 Noniyas now live in one form or another of the joint family.

Intense efforts have been made by the Noniyas to improve their economic position within the multi-caste village unit. The means utilized have been in reclamation of alkaline waste lands, unusually intensive farming, and a strong pattern of seasonal and recurrent labor migration. Thirty-two percent of the total annual income of the community is derived from outside wages. The total economic organization of the community is analyzed in terms of capital, labor, productive methods, income, and expenditures to highlight differential mobility patterns as expressed through economic efforts. Annual agricultural and cash income for three consecutive years is reported for a 50 percent sample of Noniya households. Family budgets and expenditure are reported for the same sample for a one year period.

Investigation was conducted in Bombay to determine the pattern of social and economic life of Senapur men of all castes working in that city. Forty-six Senapur men of 12 castes (including 11 Noniyas) were interviewed and studied for an eight-week period. Bombay income is positively correlated with village caste and occupational position indicating that little social mobility accrues simply from the process of urban migration. Senapur men remain strongly tied to the village during the time they are in the city and remit most of their earnings to the village. Analysis of Noniya family budgets indicates a distinct pattern of expenditure for those households with over 45 percent of their total income in the form of cash. These households contain two or more urban migrants, purchase more manufactured goods than do their neighbors, and exhibit other signs of social striving.

Case studies are presented of ritual, educational, and political attempts of the caste community to raise itself in the hierarchy of the multi-caste village, indicating the factors in the changing Indian situation which impinge upon this particular caste community's mobility strivings. There is indication of a perceptible change in the orientation of the Noniyas from caste to class values. The growing emphasis on wage labor, money rather than barter, the impact of the urban migration pattern, and the recent joining together of castes of the tenant class into political parties, are all signs of this shifting of emphasis within the endogamous caste to accommodate class values.

Microfilm $5.40; Xerox $19.15. 424 pages.

EXPERIMENTAL RABIES IN THE OPOSSUM (DIDELPHIS MARSUPIALIS VIRGINIANA KERR)

(L. C. Card No. Mic 61-1596)

Thomas Robert Bonner Barr, Ph.D.
University of Illinois, 1961

The study involved 21 adult opossums and 12 litters containing 98 young opossums ranging from 38 to 98 days in age. Experimental results were obtained from 19 adult opossums, 65 young opossums, and the mothers of four litters; using a strain of street rabies virus isolated from a skunk (Mephitis mephitis).

Five adult opossums developed clinical rabies after intracerebral inoculations of rabies virus. Four intracerebral passages were made in adult opossums. Clinically infective doses ranged from 457.1 to 75,510 mouse LD_{50}. Susceptibility of adult opossums to the virus was very variable, confirming a mechanism of natural resistance. Refractory results in 14 adult opossums were attributed to this mechanism, rather than to a naturally-acquired immunity.

Susceptibility of young opossums, inoculated intracerebrally, decreased as their ages increased; and, except in one case, the incubation periods, in those that became clinically rabid, increased also. Young opossums were less susceptible by intramuscular inoculation than by intracerebral inoculation.

Salivary glands were infected in two adult opossums representing the third intracerebral passage of virus. Tropism for the salivary glands was apparently not reduced by serial, intracerebral passage. In young opossums there was no apparent relationship between age and the dose of virus required to cause salivary gland infection. Salivary glands were infected only in members of each group of opossums that were inoculated with the largest viral doses.

In one infected adult opossum, the adrenal gland, kidney, and spinal cord tissues were infected. Their possible mode of infection was discussed. Of five 45-day-old opossums in one litter, eight of which became infected after intracerebral inoculation of massive doses of virus, spinal cords were infected in four, adrenal glands in two, and salivary glands in one.

It was not confirmed that one passage of rabies virus through an opossum alters its virulence for mice. If such an alteration was accomplished, it occurred only after four, successive, intracerebral passages in opossums. In an opossum of the fourth passage, a low viral titer in the brain tissue made three mouse passages necessary for identification of the virus. The low titer could not be explained.

A single, intracerebral passage through a young opossum caused no demonstrable effect on pathogenicity of the virus for adult opossums. A similar, single passage in another young opossum caused no demonstrable effect on its pathogenicity for young opossums.

Inclusion bodies were observed within the hippocampal neurones of three young opossums inoculated intracerebrally with sub-lethal doses of rabies virus. Inapparent rabies occurred in one. Possible significance of this carrier state was discussed.

Three adult opossums developed serum titers of rabies-neutralizing antibodies. The immune response was probably rabies-specific. It was unknown whether the titers represented significant levels of immunity. In 14 inoculated adult opossums, no demonstrable, immune, serologic reaction occurred. Opossums can apparently resist rabies virus in the absence of demonstrable serum antibodies.

Sub-lethal, immunizing infections probably occur in only a minority of opossums exposed to potentially lethal doses of rabies virus. Sera from 144 wild opossums were negative for rabies-neutralizing antibodies; but this was not reliable evidence that the animals had not experienced exposures to rabies virus.

Tests of tissues and sera indicated no evidence of transmission of virus from infected young opossums to three mother opossums, or to uninoculated litter-mates. Sub-lethal doses of virus did not cause production of rabies-neutralizing antibodies in the sera of 10 young opossums.

Clinical signs observed in opossums were those of "dumb rabies" rather than "furious rabies." Possibilities that rabid wild opossums would transmit the disease to other wild animals, by biting, appeared to be slight.

Microfilm $2.75; Xerox $4.60. 90 pages.

QUANTITATIVE ASSAYS OF SELECTED HYDROLASES OF MONONUCLEAR CELLS FROM TUBERCULOUS AND NORMAL RABBITS

(L. C. Card No. Mic 60-3624)

William Ernest Bennett, Ph.D.
University of Pennsylvania, 1960

Supervisor: Arthur M. Dannenberg, Jr.,

Hydrolases from tuberculous and control rabbit MN exudate cells were quantitatively compared by biochemical techniques. For this purpose, these cells were first standardized by counts, differentials, and DNA determinations and their viabilities evaluated. Then their enzymes were studied employing the following substrates:

> Acid denatured and alkaline urea denatured hemoglobin and benzoyl d, 1 phenylalanine B naphthol ester as proteinase substrates, methyl butyrate and B naphthol acetate as esterase substrates, and a stable emulsion of coconut oil as the lipase substrate.

Of these enzymes, only the mononuclear lipase was greater in the tuberculous than in the control rabbits. This

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

possibly represents an adaptation of the host enzyme (s) to some lipid from the bacteria or from dead or dying cells of the host. Though the other mononuclear enzymes studied were not altered by the tuberculous process, their characterization may be of benefit in the elucidation of other functions of these reticul-endothelial cells.

Microfilm $2.75; Xerox $3.00. 43 pages.

THE PHYSIOLOGY OF SPORES OF A BACILLUS: MASS PRODUCTION, NORMAL AND "ENDOTROPHIC" SPOROGENESIS, AND PERMEABILITY.

(L. C. Card No. Mic 61-1719)

Samuel Harold Black, Ph.D.
University of Michigan, 1961

The bacterial endospore holds a singular position in nature: it is the most heat-tolerant form of life known. Although the precise mechanism is not yet understood, the spore's remarkable thermostability increasingly appears to be associated with a distinctive anatomy as well as peculiar biochemical components or processes. An integrative study of these features was undertaken, therefore, in the hope that information not apparent from separate studies in morphology or physiology might be gained.

I. Mass production of spores. A method is described for the bulk cultivation and harvest of spores of the aerobe, Bacillus cereus strain terminalis, in a partially defined, liquid medium. The fortuitous finding that sporulation ensued, in this system, in a synchronous manner occasioned the experiments detailed in sections II and III. The high yield, homogeneity, and purity of the spores so obtained made feasible the experiments recorded in section IV.

II. Development of fine structure, thermostability, and dipicolinic acid during normal sporogenesis. The successive stages of development during spore formation were followed by phase contrast microscopy and in electron micrographs of ultrathin-sectioned cells. Structural maturation was correlated with some physiological changes accompanying the sporulation process. Just after the forespore became anatomically apparent, dipicolinic acid (DPA) synthesis began. During this critical transition period the developing spore gradually became refractile and non-stainable, and thin-sectioned cells revealed a primordial cortex layer in the integument. An increase in heat resistance was first detectable when the DPA level reached one third of the maximum; this finding indicated the possibility of a correlation between heat resistance and DPA, but only above a threshold level of the compound.

III. Calcium reversal of the heat susceptibility and dipicolinate deficiency of spores formed "endotrophically" in water. Spores of the test organism formed "endotrophically" after transfer of granular vegetative cells to distilled water were found to be only partially refractile, slow to germinate, relatively susceptible to heat, and deficient in DPA. Calcium ions alone, added in low but critical concentration soon after the vegetative cells were placed in water, relieved completely all of the abnormalities. Although the water-formed spores were heat sensitive, they were as resistant as normal spores to gamma radiation or phenol.

IV. The permeability of spores. Total solute-uptake measurements using masses of heat-stable, dormant spores revealed that tritium-labeled water exchanged freely with all of the removable spore water and that it could enter an apparent 86 per cent of the spore volume. Glucose could permeate an apparent 51 per cent of the spore volume; the uptake was relatively independent of environmental variables and was considered to be diffusional. Other small molecules entered the dormant spore to a variable extent: electrostatic charge, solubility in lipid, and molecular weight were controlling factors. Solutes with a molecular weight of about 400 to 100,000 were taken up in inverse proportion to the logarithm of their weight; larger molecules were excluded. Germinated spores were considerably more permeable to small molecules than were dormant spores. Experiments attempting to localize solute uptake in dormant spores indicated that permeation is restricted to a peripheral region. It was concluded that a relatively deep-positioned barrier, possibly the cortex, limits penetration and may protect an essentially anhydrous core. The barrier breaks down during germination, allowing, thereby, free entry of exogenous materials to the rehydrated and reactivated protoplasm.

Microfilm $2.75; Xerox $9.70. 212 pages.

STUDIES ON THE ACCUMULATION OF TRYPTOPHAN BY ESCHERICHIA COLI

(L. C. Card No. Mic 61-1598)

John Angelo Boezi, Ph.D.
University of Illinois, 1961

The accumulation of tryptophan by resting cell suspensions of E. coli T3A has been studied. The uptake of tryptophan requires energy as evidenced by the fact that dintrophenol and azide inhibited the accumulation of the radioactive amino acid. Optimal uptake of the amino acid was achieved by adding formate to the reaction mixture. The addition of glucose or pyruvate to the reaction mixture inhibited the accumulation of tryptophan.

The selectivity of the system responsible for the accumulation of tryptophan was demonstrated (1) by showing that other natural occurring amino acids with the exception of serine do not inhibit the accumulation of tryptophan, and (2) by testing the effect of other indole derivatives on the uptake of tryptophan. The system responsible for the accumulation of tryptophan is non-stereospecific. The uptake of L-tryptophan was inhibited by D-tryptophan.

The tryptophan accumulating system is inducible, i.e., it is formed by the cells in increasing amounts in response to increasing amounts of tryptophan in the growth medium. The induction of the tryptophan accumulating system is inhibited by chloramphenicol suggesting that at least one component of the system is an inducible protein. Although glucose inhibits the induced synthesis of many enzymes, it does not inhibit the induction of the tryptophan accumulating system. In addition to the inducer, tryptophan, the formation of the tryptophan accumulating system requires

the presence of acid hydrolyzed casein in the growth medium. Interpretation of this requirement is difficult, but it suggests that the tryptophan accumulating system has other components in addition to the inducible protein.

The variation of the tryptophan content of the amino acid pool of exponentially growing cultures was correlated with the properties of the tryptophan accumulating system. Cells which do not possess an active tryptophan accumulating system contained little free tryptophan in comparison to cells that possess an active system. Furthermore, exponentially growing cells in which the activity of the tryptophan accumulating system was inhibited by the added glucose in the growth medium contained little free tryptophan.

The physiological significance of the inhibition by glucose and pyruvate of the activity of the tryptophan accumulating system was investigated. A hypothesis was developed to explain the inhibition by glucose of the induced synthesis of tryptophanase. It was proposed that the inhibition of the induced synthesis of tryptophanase was a result of the exclusion of the inducer, tryptophan, from the cell. The exclusion of the inducer from the cell is achieved by an inhibition by glucose or one of its derivatives of the activity of the tryptophan accumulating system. However, the proposal was shown to be incorrect by demonstrating that ribose which is equally effective as glucose in excluding tryptophan from the cell is not nearly as effective as glucose as an inhibitor of the induced synthesis of tryptophanase. Additional evidence inconsistent with the hypothesis was obtained by showing that the accumulation of anthranilate, which is an apparent inducer of tryptophanase, is not affected by glucose although the induction of tryptophanase by anthranilate is glucose sensitive.

Microfilm $2.75; Xerox $4.20. 77 pages.

A STUDY OF PLEUROPNEUMONIA-LIKE ORGANISMS (PPLO) ASSOCIATED WITH SYNOVITIS IN TURKEYS AND CHICKENS

(L. C. Card No. Mic 61-728)

Richard Ross Chalquest, Ph.D.
Cornell University, 1960

The purpose of this study was to isolate and identify the etiological agent of infectious synovitis(IS). This agent was generally presumed to be a large virus, until Lecce (Biology of the Pleuropneumonia-Like Organisms, Annals of the N.Y. Academy of Sciences, 79, Art. 10, 670, 1960) reported the isolation of PPLO from material containing the IS agent. The isolation of PPLO from similar material by Lecce's technique was confirmed in this study. The growth obtained by this technique did not permit further study of these organisms. After many attempts, a more satisfactory culture medium was developed. The broth media was PPLO broth without crystal violet (Difco) which contained 0.1 percent diphosphopyridine nucleotide (DPN), 0.1 percent L cysteine (free base), 10 percent heat inactivated swine serum, 1 to 1,000 concentration of thallium acetate per ml. and 1,000 units of penicillin per ml. A solid media of PPLO agar (Difco), which contained 0.1 percent DPN, 10 percent heat inactivated swine serum, thallium acetate, and penicillin was also satisfactory for growth of these organisms. The broth media were incubated aerobically; the solid media were incubated in the candle jar.

The colonies isolated with this media from infectious allantoic fluid or synovial fluid of seven different isolates of the IS agent resembed an S_6 type PPLO in morphology. However, all of these isolates were found to be serologically distinct from S_6 type PPLO. Three isolations of S_6 type PPLO and two which were not S_6 type were made from field cases of IS. Pathogenicity studies conducted with the new type PPLO demonstrated that its effects in chickens and turkeys paralleled the signs, gross and microscopic lesions attributed to IS agents previously described.

Microfilm $2.75; Xerox $4.40. 82 pages.

MECHANISMS OF ALKANE OXIDATIONS BY BACTERIA

(L. C. Card No. Mic 61-1919)

William Robert Finnerty, Ph.D.
State University of Iowa, 1961

Chairman: Professor R. E. Kallio

A strain of a paraffin-oxidizing organism designated H.O.1-N was used to study the mechanism(s) involved in the oxidation of normal alkanes.

An earlier hypothesis of hydroperoxidation occurring as the initial step in the oxidation of alkanes was supported by manometric and chemical studies. Alkyl hydroperoxides in the proper concentration were shown to be efficiently utilized by the organism. A positive chemical test showed alkyl hydroperoxides to be present intracellularly when the organism was grown at the expense of alkane, but not when the organism was grown on a nonhydrocarbon substrate. The ability of resting cells to produce a positive ester test from alkane and 1-alkyl hydroperoxide served to implicate more decisively the initially occurring hydroperoxidation.

The origin of the carbon atoms in the esters synthesized by the organism was studied by the use of hexadecane-1-C^{14} and tetradecane-1-C^{14}. Degradation of the palmitic acid moiety from each ester showed that no reorganization of alkane carbon occurs in the formation of ester. Cetyl palmitate was formed as a result of the direct esterification of palmitic acid and cetyl alcohol. Tetradecyl palmitate was formed as a result of the esterification between palmitic acid and tetradecanol. Palmitic acid in tetradecyl palmitate is synthesized by two carbon additions to an existing fourteen carbon intermediate.

Microfilm $2.75; Xerox $5.00. 99 pages.

STUDIES ON THE FERMENTATION OF GALACTOSE BY STREPTOCOCCUS FAECALIS

(L. C. Card No. Mic 61-2033)

Thomas Tomio Fukuyama, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. D. J. O'Kane

The pathway and mechanism by which the end-products of galactose fermentation are formed in S. faecalis was investigated using dried cell and cell extract preparations of this bacterium. Lactic, acetic and formic acids and ethyl alcohol were the major end-products of galactose fermentation by galactose-grown cultures; lactic acid representing 50 per cent of the galactose fermented. In contrast, glucose fermentation is characterized by the conversion of 90 per cent or more of the sugar fermented to lactic acid. Galactose-1-C^{14} is fermented predominantly to methyl-labled end-products which is compatible with the Embden-Meyerhof pathway of glucose fermentation. Differences in galactose and glucose fermentation patterns must, therefore, be attributed to alternate routes of pyruvic acid metabolism. pH was not found to be the cause of this change in metabolism.

Greater stimulation of galactose fermentation by hydrogen acceptors suggests DPNH oxidation as a rate-limiting step in the fermentation of the sugar. Investigation of the potential capacities of the Leloir pathway enzymes indicated they could not be limiting the over-all fermentation rate of galactose. A possible feedback inhibition of galactokinase or the inhibition of UDPGalactose-4-epimerase by DPNH, however, are not excluded.

Microfilm $2.75; Xerox $4.00. 73 pages.

A STUDY OF A BACTERIOPHAGE INFECTING A STRAIN OF BACILLUS

(L. C. Card No. Mic 61-1615)

Ivan Delmar Goldberg, Ph.D.
University of Illinois, 1961

A bacteriophage has been isolated which lyses cultures of Bacillus cereus T. The head of this phage is about 75 mμ in diameter; the tail averages about 400 mμ in length and 25 mμ in diameter. The phage is assayed by the agar layer method using nutrient agar as the plating medium.

When phage is added to an actively growing culture (two hours after a 10% transfer into fresh medium) at a multiplicity of one or two, mass lysis occurs only after the culture has undergone the morphological and biochemical changes typical of the prespore stage.

For synchronous cells less than seven hours old, the time required for mass lysis is dependent upon the time of phage addition. The older the culture the shorter is the interval between phage addition and mass lysis. However, if phage is added to a culture seven hours or older, spores are produced which contain heat resistant phage determinants. If these spores are heated at 80°C for 30 minutes, and inoculated into fresh media, the resulting culture lyses. Thus, B. cereus T can sporulate when infected with virulent phage and the spores so produced contain virulent phage determinants.

Phage determinants can also be incorporated into heat sensitive spore-like bodies. The phage determinants incorporated into such structures are essentially heat sensitive.

The effect of various inhibitors of sporulation on lysis by phage has been studied. Alpha picolinic acid and ethyl pyruvate inhibit both lyses and sporulation. Ethyl malonate inhibits both processes when added to cultures in which the pH is falling but inhibits only sporulation when added to cultures in which the pH is rising. Ethyl succinate inhibits sporulation, but has no effect on lysis at any time. Dipicolinic acid, on the other hand, prevents lysis but has no effect on sporulation. The spores produced in the presence of dipicolinic acid contain heat resistant phage determinants.

The infected spores produced in the presence of dipicolinic acid can be cured of phage infection by repeated subculture in medium containing this compound. This curing is not the result of the selection of a resistant mutant, since, when phage is added to a culture grown from such a cured spore inoculum, it lyses completely.

On the basis of the data obtained during this investigation, it is postulated that phage protein and spore protein are synthesized from a common metabolic pool.

Microfilm $2.75; Xerox $4.00. 73 pages.

GENE-ENZYME RELATIONSHIPS IN THE BIOSYNTHESIS OF ADENYLIC ACID IN SALMONELLA

(L. C. Card No. Mic 61-2035)

Edith Goldberg Gollub, Ph.D.
University of Pennsylvania, 1961

Supervisor: Joseph S. Gots, Ph.D.

The sequence of reactions involved in the biosynthesis of purines in microorganisms has been largely due to the work of Gots, Magasanick, Lieberman and others using purine-requiring mutants of E. coli, Salmonella typhimurium and Aerobacter. In the pathway leading specifically to adenine formation, 2 types of non-allelic mutants have been found indicating that 2 reactions are involved in the sequence. These reactions are: first, the aspartylation of inosinic acid to form the intermediate adenylosuccinic acid (AMPS); second, the splitting of this compound to yield the end-product, adenylic acid. The present work was undertaken to investigate the relationship of these two enzymes to the genetic state of the organisms involved. This was done by a combined genetic and biochemical analysis of mutants of Salmonella that are specifically adenine requiring.

The organisms used in this study were wild-type Salmonella LT-2, adenine specific mutants ade 1, ade 65, ade 3, ade 12, ade 12M, 533-157 and 533-643; and ade-12S. For purposes of comparison in certain cases, E. coli B and several adenine requiring mutants of B were used – B 97, B 99. Transduction analyses as well as accumulation studies of the Salmonella mutants separated the mutants into 2 well defined loci: the ade A locus comprised of mutants blocked in the conversion of inosinic acid (IMP) to AMPS; these are ade 1, ade 65, which accumulate hypoxanthine and guanine compounds in non-proliferating

systems. The ade-B locus is comprised of mutants blocked at the second reaction, conversion of AMPS to adenylic acid (AMP) and include ade 12 and ade 13. The enzyme involved here, adenylosuccinase, is a bifunctional one, catalyzing the splitting of succinylaminoimidazole-carboxamide (SAICAR) to form aminoimidazole carboxamide (AICAR) prior to the formation of IMP; thus, these mutants, as well as the double mutants, ade 3, ade 12M, 533-157 and 533-643 accumulate SAICAR, the substrate of the first blocked reaction.

Enzymatic analyses revealed that mutants at the ade A locus lacked the enzyme adenylosuccinate synthase as measured by spectrophotometric analysis; while those blocked at the ade-B locus lacked the enzyme adenylosuccinase. Adenylosuccinase activity was measured both by the SAICAR → AICAR reaction using the Bratton-Marshall test for diazotizable amines, and by the AMPS → AMP reaction using spectrophotometric analysis. The double mutants lacked both enzymes. It was shown that lack of adenylosuccinase was not associated with the presence of an inhibitor in the ade-B mutants; furthermore, all attempts to uncover enzyme activity by various methods, i.e., gel adsorption, dialysis, heat, etc., failed to do so while some increased the activity of the wild-type enzyme. Fractionation of adenylosuccinase was carried out by DEAE column chromatography to attempt to separate the two activities of the enzyme but no separation was effected. Further proof of the bifunctional nature of the enzyme was shown by the inhibition by AMPS of the SAICAR → AICAR reaction.

Substrate competition was marked here while the related compounds argininosuccinic acid and AMP failed to show any inhibition at all.

Restoration of adenylosuccinase was shown to occur by various mechanisms: by spontaneous reversion to wild-type; by suppressor mutation, involving a second mutation at a separate locus from the ade-B locus which suppresses the effects of the mutation at the ade-B locus. Enzyme activity here is restored to about 15% of wild-type activity. The suppressor ade-12 Sμ can grow in the absence of adenine and the accumulation of SAICAR is markedly decreased. Restoration was also effected by complementation as shown by the formation of minute colonies on transduction of ade 12 by ade 3, both of which lack the enzyme.

Thus, the present work has shown that the two enzymes involved specifically in the biosynthesis of adenylic acid are under genetic control.

Microfilm $2.75; Xerox $3.00. 57 pages.

HOST-VIRAL RELATIONSHIPS IN MIXED VIRAL INFECTIONS

(L. C. Card No. Mic 61-1364)

Sidney Halperen, Ph.D.
The University of Texas, 1961

Supervisor: Dr. S. Edward Sulkin

The pathogenic effects on mice of mixed infection with Coxsackie virus and poliovirus may be altered by variations in virus serotype, dosage, route of inoculation and age of the animals. Prior intracerebral inoculation of types 1 and 4, Group B Coxsackie viruses afforded no protection to adult mice against intracerebral challenge with type 2 poliovirus, while intracerebral and intraperitoneal inoculation of type 3, Group B Coxsackie virus limited the progress of poliomyelitis in these animals. In the latter experiments proliferation of Coxsackie virus was observed only in those animals that received subsequent poliovirus injections. No evidence for interference with poliovirus infections of adult mice was obtained when prior inoculation of Group A Coxsackie viruses was employed. Type 4, Group A Coxsackie virus, however, enhanced subsequent poliovirus infection by decreasing the incubation period. In addition, it was found that prior inoculation of immature mice with poliovirus resulted in a sparing effect on the early stages of infection with type 4, Group A Coxsackie virus. These studies therefore suggested further credence for the assumption that preemption of certain cells by one agent is requisite for alterations in the progress of the other. A change in specific susceptibility of animals by age selection, or by use of agents with differing tissue tropisms caused anticipated marked variation in experimental results.

Studies of mixed infections of several tissue culture systems with active and inactivated agents suggested possible mechanisms involved in the in vivo experiments. Pretreatment of HeLa cell monolayers with active type 3, Group B Coxsackie virus increased the time of appearance of poliovirus cytopathogenesis while ultraviolet-inactivated Coxsackie virus decreased this interval. Further studies provided evidence that these effects were due to the activity of the Coxsackie virus particle, per se, rather than to a suspected extraviral component analogous to that found in influenza virus interfering systems.

Suspended original HeLa cell cultures, as well as the S3 line, infected with each agent demonstrated striking variations in cycles of virus multiplication and cell degenerative activities between Coxsackie and poliovirus. Such cell cultures exposed to both agents simultaneously exhibited a delay in cytopathogenesis in addition to reciprocal virus interactions. An inhibition of poliovirus adsorption and release occurred along with a late, abnormally high ratio of free to cell-associated Coxsackie virus. It is suggested that the latter observation may have been due to the premature release of Coxsackie virus from doubly infected cells by the increased permeability and disintegration characteristic of poliovirus infection.

From these data it appears likely that the in vivo effects of mixed infection with Coxsackie and poliovirus may be explained on the basis of the results obtained from experiments in tissue culture systems.

Microfilm $2.75; Xerox $7.00. 149 pages.

PRODUCTION AND PURIFICATION OF THE MYXOMA AND FIBROMA VIRUSES

(L. C. Card No. Mic 61-1537)

Anne Cronin Jayne, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Duard L. Walker

The viruses causing myxomatosis and fibromatosis in rabbits are related in many ways. They are of similar size and shape, have the same very limited host range, infecting only rabbits of the genuses Orychtolaqus and Silvalaqus (and occasionally rabbits of the genus Lepus), apparently are transmitted in a similar manner, share common antigens, and are genetically associated as shown by the phenomenon of transformation. Despite their similarity, infection with each of these viruses produces a distinctly different disease picture. In the Orychtolaqus rabbit, the myxoma virus causes a generalized, rapidly fatal inflammation, while the fibroma virus produces benign self-limiting localized tumors.

Studies on cultivation and purification of myxoma and fibroma viruses were made as preliminary work for a study of their chemical composition. It was found that optimum growth of both viruses was obtained from inoculation of rabbits, the myxoma virus being obtained from the skin after dermal scarification and the fibroma virus from the testis.

The pH range in which the myxoma virus could be kept without inactivation was delineated. It was shown that the virus could best be suspended in 0.004 M citrate-phosphate buffer.

Attempts to purify and concentrate the myxoma virus were not completely successful primarily because of agglutination of virus particles and adsorption of particles to debris. Differential centrifugation was found to be useful. The technique was made less useful by the aggregation of the virus in high centrifugal fields and its adsorption of tissue debris, with its subsequent loss upon removal of debris following slow centrifugation. The non-ionic detergent Tween 61 (polyoxyethylene-4-sorbitan-monostearate) was able partly, though not completely, to eliminate adsorption and aggregation. Cellulose ion-exchange chromatography was found not to be of use. No viable virus passed through columns of the resins tried. Flurocarbon extraction was found to remove protein and particulate debris. The myxoma virus was found, however, to be susceptible to the flurocarbon and loss of viable virus was noted before extraction of protein was accomplished to a helpful degree. Removal of debris by enzymatic digestion was attempted. Preparations of trypsin, papain, pangestin, and hyaluronidase were found not to decrease infectious myxoma virus but difficulty was encountered in removing the enzyme from the virus, and the amount of actual purification accomplished was not certain. It was found that ammonium sulfate and sodium chloride, under controlled conditions, could precipitate the myxoma virus. Ammonium sulfate also precipitated the protein contamination present in the preparation so that concentration but not purification was accomplished. Sodium chloride precipitation was erratic for undetermined reasons. Purification did seem to be accomplished by this process. No precipitation of the myxoma virus was found in methanol solutions. Density gradient centrifugation using sucrose as a suspending medium appeared to be a promising method of purification. Adsorption of the virus to debris was an unsolved problem which interferred with the effectiveness of the technique.

Microfilm $2.75; Xerox $9.70. 211 pages.

STUDIES ON ENDOTHELIAL LESIONS OF THE RABBIT CORNEA INDUCED BY NEWCASTLE DISEASE VIRUS (NDV) IN VIVO AND IN VITRO AND THEIR SUPPRESSION BY CHEMICAL AGENTS.

(L. C. Card No. Mic 61-1328)

Jang Ok Oh, Ph.D.
University of Washington, 1960

Chairman: Charles A. Evans

Injection of a large amount (10^9 PFU) of Newcastle disease virus (NDV) into the anterior chamber of the rabbit eye caused a "toxic" reaction which was characterized by edema of the corneal stroma with extensive damage of corneal endothelium. No increase of infectious virus in aqueous humor was associated with the above reaction.

The edema of the cornea was preceded by two characteristic microscopic endothelial lesions of the cornea which were demonstrable by staining with silver nitrate. They were endothelial rosettes composed of well-isolated radially arranged clusters of endothelial cells, and "fusions" of adjacent endothelial cells as indicated by failure of the silver stain to delineate cell boundaries. Both microscopic lesions began to appear on the cornea within 1 hour after the virus inoculation, but in later stages of the toxic reaction, the fusion appeared to be the predominant change in the corneal endothelium. Fusion was formed by NDV only in the in vivo system, while the endothelial rosettes occurred both in vivo and in vitro.

The number of endothelial rosettes appearing on the cornea was related to the amount of virus inoculated into the anterior chamber of eye. The rosettes were produced by 1/10 or 1/100 the amount of virus required to produce a macroscopically visible toxic reaction. The capacity of virus to induce endothelial lesions was destroyed by exposure of virus to specific antiserum or to heat.

The presence of the iris was found to be essential for the maximal production of endothelial rosettes by virus in vitro. The virus appeared to act on the corneal endothelial cells in cooperation with something released from the iris in response to exposure to virus.

Pretreatment of cornea with RDE markedly suppressed the production of rosettes, fusions and corneal opacity by NDV in vivo and the formation of rosettes by NDV in vitro. Pyrilamine maleate and LSD showed a marked suppressive effect on the production of rosettes by NDV in vitro and a moderate effect on the production of corneal opacity by virus in vivo. In the in vitro system RDE appeared to exert its effect on corneal endothelium, whereas pyrilamine and LSD acted on iris to suppress the production of endothelial rosettes by NDV. The suppressive effects of pyrilamine and LSD on the production of rosettes by NDV were not due to inactivation of virus or modification of endothelial cells of cornea by these compounds. Intravenous

injections of nitrogen mustard (HN2) induced a long lasting suppressive effect on the production of corneal opacity and endothelial fusions by NDV, but this compound caused no significant suppressive effect on the formation of rosettes by virus. The suppressive action of HN2 on the production of corneal opacity and fusions was not related to its suppressive effects on leukocytes or on infectivity of the virus.

The endothelial rosettes were also produced by injecting various nonviral agents, such as compound 48/80, reserpine, polymxin B, distilled water, etc., and by mechanical trauma of corneal endothelium. Thus the rosettes appeared to be a relatively nonspecific manifestation of damage. The production of rosettes by compound 48/80 in vitro was also markedly suppressed by pretreatment of the anterior chamber with pyrilamine maleate and LSD.

In the corneal endothelial cells grown in tissue culture, NDV produced degenerative changes in the cells with characteristic cytologic effects which appeared to be virus specific. These cytologic effects were eosinophilic intracytoplasmic inclusions, and multinucleated cells. The latter did not appear regularly in the cells infected with NDV.

The studies on growth curves of the virus in corneal endothelial cells in the tissue cultures and the studies with fluorescent antibody indicated that the tissue cultures of corneal endothelial cells were capable of supporting synthesis of new viral antigen and multiplication of infectious virus. Microfilm $2.75; Xerox $9.25. 204 pages.

A STUDY OF THE ANTIGENIC COMPONENTS OF GARDNER LYMPHOBLASTOMA 6C3HED

(L. C. Card No. Mic 60-6917)

Lois Jean Paradise, Ph.D.
University of Michigan, 1960

If immunological methods are to be employed in the therapy of neoplastic disease, the isolation of tumor-specific antigens is obligatory in order to avoid destruction of the normal tissues of the host. Unfortunately, the methods most frequently used to study the specificity of materials separated from tumor cells have been serological tests and not the reactions of the host. It was proposed, therefore, to fractionate the mouse lymphoblastoma 6C3HED and to compare its fractions with those of homologous normal C3H mouse tissues in several kinds of tests. For preliminary studies, two types of cytotoxicity test which employed rabbit antitumor serum were performed. In one of these, the decreased ability of antiserum to destroy tumor cells after adsorption with the fractions was determined by unstained viable cell counts using safranin 0 as the indicator. In the other, the viability of the serum-treated cells was demonstrated by their ability to produce tumors in mice. The Schultz-Dale response, using mice actively immunized to whole tumor cells, was employed to test for specificity of the tumor fractions which displayed antigenicity in the cytotoxicity tests. Many different methods of fractionation were used in attempts to isolate the tumor antigen. The technic described below produced the only active, soluble material which was found.

After the removal of large particles from a homogenate of the tumor in 2.5 volumes of M/15 phosphate buffer pH 7.4, the material which floated as the result of exposure to 105,000xg for 20 hours was removed. The remainder was rehomogenized, adjusted with a saturated aqueous solution of sucrose to a density of 1.15 g/ml, and recentrifuged at 105,000xg for 20 hours. A floating, gelatinous layer contained the antigenic components of the tumor. In both of the cytotoxicity tests the tumor fraction exhibited greater activity than did the normal tissue preparations.

In the Schultz-Dale tests, the tumor fractions either were active in stimulating the contraction of tumor-sensitized uterine muscle when the normal tissue fractions were not or, after desensitization with the normal tissue fractions, reaction to the tumor material remained. Rabbits were immunized by intravenous injection of the tumor fraction either alone or mixed with kaolin, rabbit antitumor serum, or normal guinea pig serum. When the presence of antitumor antibody in the serum of these rabbits was studied, it was found that a combination of tumor fraction and normal guinea pig serum gave the highest titres.

Further fractionation of the tumor fraction obtained by flotation demonstrated that it was possible to solubilize the antigen by treatment with 1.0 N sodium hydroxide. Chemical tests have shown the presence of proteins and lipids. Absorption spectra in the range 200-1000mμ disclosed no band of the soluble tumor fractions which was not also present with those of the spleen. Paper electrophoresis indicated that several components were present, but no distinctive difference between normal tissue and tumor preparations was observed.

Therefore, a fraction was separated from the tumor which was soluble in alkali, contained proteins and lipids, and was more antigenic, in both heterologous and isologous test systems, than were similar preparations of normal tissues. Microfilm $2.75; Xerox $4.80. 91 pages

POLYRIBONUCLEOTIDE SYNTHESIS IN A SUBCELLULAR FRACTION OF ESCHERICHIA COLI

(L. C. Card No. Mic 61-200)

Edna Seaman, Ph.D.
University of Illinois, 1960

The purpose of this investigation was to elucidate the synthesis of polyribonucleotide in a subcellular fraction of Escherichia coli, strain B. The fraction studied here was the low speed centrifugal pellet designated as the M fraction.

E. coli protoplasts were ground in a mortar prechilled to -70° C. The ground preparation was cleared of any remaining intact protoplasts in two successive centrifugations at 5000xg for five minutes. The supernatant from these spins was centrifuged at 15,000xg for 15 minutes and the resultant pellet washed twice. The 15G15P constitutes the M fraction. The M fraction has a characteristic chemical composition. It contains 2% of total protoplast RNA, 0 - 1% of total DNA (depending on the extent of washing), and 6% of total protein.

The M fraction is capable of synthesizing the following polyribonucleotides (PRN): Poly A, Poly AU, and a mixed

polyribonucleotide containing all four bases. The nature of the product is governed by the substrates provided. There is no indication of an inherent mechanism controlling the composition of the PRN.

PRN synthesis proceeds best in the presence of nucleoside triphosphates (NTP), but there is strong evidence that nucleoside diphosphates (NDP) are the more immediate precursors of PRN synthesis. The evidence is summarized below.

1. The addition of nucleoside monophosphates to an ATP utilizing system causes a marked stimulation of synthesis. The stimulation is presumably due to a generation of NDP via a myokinase system.

2. The supplementation of the M fraction with an ADP generating system (Hexokinase-Mannose system) leads to a marked stimulation of PRN synthesis.

3. The supplementation of the M fraction with an ATP generating system (Pyruvic Kinase-phosphoenolpyruvate) completely inhibits the synthesis of PRN.

4. Orthophosphate is liberated during the synthesis of PRN; there is no liberation of pyrophosphate.

5. The PRN product is susceptible to orthophosphorolysis.

The possible direct participation of nucleoside triphosphates in the synthesis has not been excluded.

The synthesis of PRN by the M fraction is stimulated by L-amino acids. The stimulation is consistent and specific. D-amino acids or the amines resulting from the decarboxylation of amino acids do not exert the stimulatory effect. The study of an amino acid auxotropho revealed that the amino acid, for which the mutant was deficient, was necessary for maximal stimulation.

There is an indication, though no conclusive proof, that PRN is synthesized on the membranes or on structures physically associated with the membranes. The PRN is released into the medium immediately following the synthesis. A small amount of RNA originally associated with the M fraction does not undergo a turnover during the synthetic process.

A partial (up to 50%) removal or destruction of the input RNA does not significantly affect the biosynthetic capacity of the M fraction. Depleting the M fraction of its DNA, on the other hand, leads to a slight but consistent inhibition of PRN synthesis. This inhibition cannot be alleviated by the addition of either native or heat denatured DNA.

It is suggested that the PRN synthesized by the M fraction of E. coli is not a biologically significant polymer. It has a very different composition from the native RNA, and its composition is apparently not governed by either an RNA or DNA template. It might well represent a nonsense storage polymer for nucleotides and/or energy to be broken down and used by the cell for the synthesis of a meaningful RNA molecule. The in vitro observations discussed above do not preclude the possibility that this same system functions quite different in situ. The cell might have internal controls governing the type of RNA produced even by this non-specific enzyme. There may be regulatory mechanisms associated with some structural components whose integrity is disrupted in the M fraction. Controls of a chemical nature may also be present in the cell; these controlling substances could be lost in an open system such as the M fraction.

Microfilm $2.75; Xerox $5.20. 102 pages.

ORIGIN, VARIATION AND PROPERTIES OF THE GENETIC ELEMENTS RESPONSIBLE FOR TRANSDUCTION OF THE "LAC" CHARACTERS.

(L. C. Card No. Mic 61-1672)

Robert Chin-Yao Ting, Ph.D.
University of Illinois, 1961

The purpose of the study was to investigate the properties of the genetic elements responsible for transduction of the lac^+ property mediated by phage P1 among Escherichia coli K-12 and Shigella dysenteriae Sh. It was found by Adams that in transduction of the lac^+ characters to Sh recipient most of the lac^+ transductants carry a defective P1 prophage persistently associated with the lac^+ genes. These transductants are immune to phage P1, do not produce any normal P1 particles, and are unstable for lac^+; some of them produce phage lysates that transduce the lac^+ characters at high frequency (HFT lysates). The genetic element controlling the lac^+ and phage immunity properties was called P1 dl. This kind of transduction is referred to as transduction by lysogenization.

In transduction of lac^+ among strains of E. coli K-12, what is usually observed is transduction by integration of the transferred markers into the recipient chromosome, without persistence of the transducing genetic element.

Using as recipient strain a derivative of K-12, strain W4032, which apparently has a deletion of the whole lac^+ region, transduction by lysogenization has been obtained. This happened only with HFT lysates from Sh lac^+ transductants, not with P1 lysates from E. coli lac^+ donors. This is an indication that the P1 dl prophage in the Sh lac^+ strains is different from the transducing elements in the lysates from the original E. coli donors.

Some of the transductants of W4032 carry a P1 dl element similar in its properties to that present in the Sh lac^+ donor; others carry a modified element, P1 dlw, which has a greater ability to persist in E. coli strain W4032 than the P1 dl element from Sh lac^+, and also differs in other properties. Thus, there is evidence that the properties of the transducing elements can change upon selection with different recipients. A possible role of recombination with the bacterial chromosome in producing these changes is suggested.

Transduction by lysogenization is greatly increased by the addition of active P1 phage. It has been shown that a single active P1 particle per bacterium gives maximum "helper" effect.

The effects of UV radiation on lac^+ transduction have been studied. The UV sensitivity of the P1 dl element, measured by transduction to Sh (without helper phage) is about the same as that of P1. When helper P1 is present, transduction to Sh becomes about 2.5 times more resistant. In both cases, the transductants carry P1 dl. This indicates that the helper phage can supply the damaged functions and probably also restore the genetic integrity of the P1 dl element. Similar results are obtained with P1 dlw, which, however, has a UV sensitivity lower than that of P1 dl and P1.

UV irradiation of active phage P1 suppresses its helper function in transduction at a slow exponential rate. Mutual reactivation between helper and P1 dl (or P1 dlw) phages is indicated.

UV irradiation has a completely different effect on transduction by integration. Small doses enhance transduction, high doses decrease it very slowly. The mechanism of these observations is discussed.

High energy electrons suppress transduction at a relatively fast rate, probably because of reduced phage attachment or injection.

Transducing lysates were fractionated by means of cesium chloride density-gradient centrifugation. Most lac$^+$ transducing particles are slightly heavier than normal Pl particles. The particles of one Pl dl isolate were heavier than either phage Pl or the Pl dlw particles derived from the same Pl dl isolate. This indicates that the genetic changes observed in the transducing elements upon selection in various recipients are accompanied by significant changes in specific gravity, hence presumably in DNA content.

Microfilm $2.75; Xerox $6.20. 127 pages.

BIOGRAPHY

MASTER OF PRACTISES. A LIFE OF WILLIAM, LORD PAGET OF BEAUDESERT, 1506-63.

(L. C. Card No. Mic 61-485)

Samuel Rhea Gammon III, Ph.D.
Princeton University, 1953

This dissertation is a biography of William Paget, emphasizing his public career as secretary of state and favorite of Henry VIII, chief adviser to Lord Protector Somerset, opponent of Northumberland, and principal minister of Mary Tudor.

It is based primarily on the Letters and Papers, Foreign and Domestic for the reign of Henry VIII and for succeeding reigns on state papers in the Public Record Office and the British Museum, supplemented by a few family papers of the Marquess of Anglesey and recent discoveries in the Northampton Record Society's Fitzwilliam Manuscripts.

Paget is examined as a typical royal servant of the Tudors rising through the civil law in the King's diplomatic service to the office of secretary of state. His work in that office is treated in some detail, two chapters being devoted to analysis of the administrative, diplomatic, and financial powers he exercised and to exposition of the influence he acquired with the aging Henry VIII. A detailed study is made of his relations with the Earl of Hertford in the last six months of the reign, during which the two men laid the plans for the coup d'état of January 1547, which gave Hertford supreme power.

Paget's growing awareness of dangerous tendencies in the Protector's foreign and domestic policies is evidenced in the striking series of letters, many of them examined here for the first time, which he wrote to the Duke in the last eighteen months of his regime. His crucial role in the fall of the Lord Protector is explained in detail together with his disillusionment with Northumberland, culminating in Paget's disgrace and imprisonment. The greatest achievement of Paget's career, the Spanish marriage of Mary Tudor, is shown to be part of a great plan by which he hoped to restore the diplomatic prestige and the domestic tranquility of his country under a powerful king consort. His attempts to gather the fruits of this marriage were frustrated by religious and political rivalry in the Privy Council, and the factions in that body are discussed at some length. The result of Paget's final desperate efforts to exalt the power of Philip in England is shown to have been his rejection by the new Queen, Elizabeth.

The major conclusions of this dissertation are:

Paget is a key figure in understanding the reigns of Edward VI and Mary.

His assistance to the Earl of Hertford was vital in the securing of the protectorship for the Earl. He was rewarded by continuing influence in the new government.

Paget's wide experience in diplomacy made him keenly aware of the decline in English power and prestige. His policies were based on the belief that the reversal of this trend was the prerequisite to the successful foreign policy which he hoped to conduct.

He believed such an improvement was impossible under a minor king or a queen regnant without a powerful foreign alliance.

His moderation in religion was a calculated policy designed to avoid religious conflict and to contribute to the stability of the government and to its strength abroad.

Microfilm $5.15; Xerox $18.25. 403 pages.

THE OCCURRENCE AND DEMONSTRATION OF SPONTANEOUS AND EXPERIMENTALLY-INDUCED MITOSIS IN MAST CELLS OF THE RAT

(L. C. Card No. Mic 61-1513)

Anton Markert Allen, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor D. Murray Angevine

In the past, very few mast cells in tissues of any species have been found in mitotic division. The general consensus now is that mast cells increase in number primarily by differentiation of various mesenchymal cells and that they rarely undergo mitosis. It is important, therefore, to determine whether mitosis is of frequent occurrence in mast cells. Do they increase in number primarily by differentiation or by cell division?

In earlier studies, mitosis may have been largely overlooked in mast cells, the nucleus not being well demonstrated through the use of metachromatic dyes. In the present studies, the author designed methods specifically to demonstrate the nucleus of mast cells and at the same time to distinguish them from other cellular elements of connective tissue. Nonmetachromatic dyes and coloring agents of complementary color were employed to produce sharp contrast between the nucleus and cytoplasm of mast cells. Hematoxylin was used in combination with neutral red, and the Feulgen reaction with methyl green.

Mast cells in spreads of mesentery from 16 normal rats were colored by the Feulgen-methyl green technique to permit identification of the mast cells and determination of their index of mitosis in relation to age and growth of the rats. Experimental induction of mitosis in mast cells was accomplished by injecting talc suspension into the peritoneal cavity of additional rats. The results of these studies indicated that mesenteric mast cells undergo considerable mitotic activity and that they divide as a function of the growth of the tissue comprising them, whether the growth be natural or experimentally induced.

Limited microphotometric studies (of 129 mast cells) revealed that the nuclei of mast cells belonged to two classes, 2C and 4C, according to DNA-content; and that 4C nuclei were morphologically distinguishable without actual measurement of DNA. The index of DNA doubling was defined for use in this study as the percentage of mast cells counted that possessed a visually detectable 4C nucleus. The index of binucleation was defined as the percentage of mast cells possessing two nuclei.

The findings based on total counts of mesenteric mast cells indicated that (1) the index of mitosis and index of DNA doubling of the mast cells and the index of growth of the rats followed similar decreasing trends as the rats advanced in age from 10 to 120 days (2) the index of DNA doubling and the index of binucleation increased in relation to the index of mitosis as the three indices decreased, suggesting that as the rats became older and their growth subsided, the initiation of karyokinesis and cytokinesis of some mast cells was somehow delayed, (3) the process of binucleation, or failure of dividing mast cells to undergo cytokinesis, was a naturally occurring process in mesenteric mast cells of the rat, (4) pairs of mast cells were formed by division of single mast cells.

Microfilm $2.75; Xerox $5.40. 110 pages.

SERUM ELECTROLYTE AND ELECTROCARDIOGRAPHIC STUDIES ON ADRENALECTOMIZED DOGS MAINTAINED FOR LONG PERIODS ON 11-DEHYDRO-17-HYDROXYCORTICOSTERONE-21 ACETATE (CORTISONE).

(L. C. Card No. Mic 61-478)

George Barlow, Jr., Ph.D.
Princeton University, 1953

Eight adrenalectomized dogs receiving a special low sodium and potassium diet were used in a series of long-term cortisone studies.

A dose of 0.93 mg/kg/day of cortisone administered intramuscularly once each day was found to be insufficient for maintenance of a normal serum electrolyte pattern. Animals maintained on this dose remained active and free from symptoms for periods ranging from 30-122 days. During this time, however, a slow but steady increase in the serum potassium occurred which eventually resulted in cardiac irregularities typical of those occurring in intact dogs infused with KCl. Such animals were subject to sudden collapse with complete loss of ability to use their limbs. These seizures usually lasted for 10-15 minutes and might occur several times a day. Recovery was spontaneous without treatment of any kind. One animal died when merely lifted from the floor. Increasing the dose of cortisone to 1.86 or 3.72 mg/kg/day corrected the cardiac irregularities.

On a higher dose of cortisone, e.g., 1.86 mg/kg/day, the serum electrolyte pattern would be maintained at normal or low normal levels, if the animals' electrolyte patterns were normal when this dosage was initiated. If, however, the serum sodium and chloride were depressed to insufficiency levels before the start of 1.86 mg/kg/day, then this dose level was ineffective in restoring a normal electrolyte pattern.

A dose level of 3.72 mg/kg/day was sufficient to correct the abnormal serum electrolyte pattern. In several dogs this amount of cortisone gave rise to electrolyte changes indicative of over-dosage. Thus it seems that the proper maintenance dose of cortisone for the adrenalectomized dog lies between 1.86 and 3.72 mg/kg/day when the animal is fed a diet as low in sodium as the one employed in these experiments.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

A dose level of 7.44 mg/kg/day caused the animal to retain sodium and chloride to a marked degree. The serum potassium, however, remained unchanged. Thus cortisone, when administered in large daily doses, possesses a DCA-like action on the serum sodium and chloride. However, the effect of this steroid on serum potassium was contrary to that of desoxycorticosterone, since relatively large doses failed to reduce the serum concentration of this cation.

In several dogs tested over an extended period on the larger doses of cortisone, moderate rises in blood pressures were observed. These rises were maintained so long as the cortisone was given, but fell to normal when the steroid was withdrawn.

The large doses of cortisone employed in these studies produced no toxic symptoms, but several dogs reacted unfavorably when cortisone was discontinued and DCA substituted for maintenance purposes.

Microfilm $2.75; Xerox $4.80. 92 pages.

NITROUS ACID-INDUCED REVERSION AT THE AD-3 LOCUS OF NEUROSPORA CRASSA

(L. C. Card No. Mic 61-1277)

William Edgar Barnett, Ph.D.
The Florida State University, 1961

The specific mutagenic action of nitrous acid has been shown by Mundry and Gierer (1958) and Schuster and Schramm (1958) to be that of deaminating the purine and pyrimidine bases in the genetic deoxyribonucleic acid. More recently, the kinetics of nitrous acid-induced-mutation have been used to determine the number of copies of the genetic material present in phage and microorganisms. The kinetics of nitrous acid-induced reverse mutation have been investigated in the present study using auxotropic strains of Neurospora crassa. The back mutation assay technique of Giles (1951) was used in these studies. In particular, an adenine-requiring strain (38701, ad-3A locus) of ultraviolet origin was used and the kinetics of the reversion process indicated that two deaminations and subsequent base substitutions were required for back mutation of this mutant. This value was taken to indicate that the physical dimensions of this particular mutant region consists of an abnormal base sequence of two nucleotides.

Experiments were carried out which ruled out the possibility that the observed increases in number of revertants were due to selection of pre-existing mutants in the population.

It was shown that the effect of nitrous acid was intensity independant, i.e., that exposure to 10% $NaNO_2$ for 5 minutes resulted in a reversion frequency equal to that obtained by exposure to 10% $NaNO_2$ for 10 minutes. Other experiments showed that varying the concentration of conidia at the time of exposure had no effect upon the reversion frequencies obtained. Together, these two experimental results indicate that cell permeability is not a factor in the calculations made.

An analysis of the inactivation of conidia by nitrous acid revealed that nuclear death was a result of approximately 1000 deaminations.

Suppressor analyses were carried out in order to determine whether nitrous acid was inducing true revertants or suppressor mutations. Thus far, test-crosses with ten homocaryotic revertant strains have not demonstrated the presence of suppressors. In the most extensively analyzed case, no suppressor mutation has been found in tests which delimit their occurrence to within 0.0016 crossover unit. These experiments do not, however, rule out the possibility that intragenic suppressors do occur.

Five other adenine-requiring strains of Neurospora were found not to revert when exposed to a concentration of nitrous acid which killed 90% of the conidia exposed. An inositol-requiring strain (37401) gave mutation kinetics which indicated that reversion at this locus is accomplished by two or more qualitatively different mechanisms. Since it is known that a certain frequency of the reversions induced in this strain are a result of suppression rather than true back mutation, the two mentioned mechanisms are probably the induction of suppressor mutations and true back mutants.

It was concluded that nitrous acid-induced reverse mutation may offer a useful tool for the determination of the dimensions in nucleotides of many point mutations.

Microfilm $2.75; Xerox $3.00. 55 pages.

GENETIC ANALYSIS OF PURINE-REQUIRING MUTANTS OF SALMONELLA TYPHIMURIUM

(L. C. Card No. Mic 61-2025)

Robert G. Coon, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Joseph S. Gots

Genetic analysis of phenotypically similar purine-requiring mutants of Salmonella typhimurium on the basis of alternative requirement for purines and the accumulation of 5-aminoimidazole ribonucleoside (AIR) has demonstrated the presence of at least two distinct groups: adeC and adeE. Complementation analysis permitted further division of the adeE locus into two complementation groups: $adeE_1$ and $adeE_2$. The symbol "ade" indicated the nutritional supplement necessary for growth of the mutants in minimal medium: adenine, guanine, xanthine or hypoxanthine. The capital letter designated the locus involved.

Transduction techniques provided an easily controlled experimental system for the study of genetic transfer between mutants of S. typhimurium. Genetic studies with 42 purine-requiring mutants comprised 3 phases: 1) description of phenotypically similar AIR-accumulating mutants, 2) genetic analysis of such mutants by means of complete and abortive transductions, 3) genetic analysis of the original mutants by means of suppressor mutations. It was possible to separate the AIR-accumulating mutants into adeC (4 mutants), $adeE_1$ (28 mutants) and $adeE_2$ (8 mutants) using complementation and recombination data. Two mutants (ade-4 and ade-8) complement with adeC but are non-complementary with either subloci of the adeE locus and may represent mutation between subloci or "double" mutants within the adeE locus. Both ade-4 and ade-8 demonstrated reciprocal recombination

and recombination between members of the adeE locus. Multisite mutations were ruled out as all mutants demonstrated the ability to revert to prototrophy.

Prototrophic "revertants" which were able to grow in minimal medium without purines and continued to accumulate AIR were found to be due to suppressor mutations. The presence of the suppressor genes was shown by means of transduction analysis involving the demonstration of the suppressor gene in a strain carrying the wild-type allele of the mutant gene. In the case of the adeC mutants, the original mutant gene could be demonstrated in the suppressor strain by selection and recovery after transduction of a mutant of the guaA locus which is closely linked to the adeC locus. The suppressors of mutants of the adeC locus are allele-specific, suppressing only the parent strain from which it was derived. The suppressor mutants derived from mutants of the adeE locus are specific for the locus but not for individual alleles within the locus. All the known mutants of the adeE locus are suppressed by any one of the adeE suppressors, including mutants of both complementation groups of this locus.

Microfilm $2.75; Xerox $3.00. 54 pages.

INTER-LINE AND INTRA-LINE VARIABILITY IN A POPULATION OF DROSOPHILA SUBJECTED TO TWO INTENSITIES OF SELECTION IN EACH OF TWO DIRECTIONS

(L. C. Card No. Mic 61-1602)

John Clarence DeFries, Ph.D.
University of Illinois, 1961

The objective of this study was to measure the variability of response to selection in order to determine the importance of random variation in a selection program. A large population of Drosophila affinis Sturtevant which had been trapped and then randomly mated in the laboratory was chosen for the study. The characteristic studied was body weight; all flies were weighed individually to the nearest microgram on a micro-balance which had been found to give reliable weighings.

Various parameters were estimated from large samples representing generations 12, 13 and 19 of random mating. The average intra-sex body weight of these three samples was 867.14, 848.62 and 792.44 micrograms, respectively; the average body weight of females was approximately 200 micrograms greater than that of males. Highly significant variance ratios indicated that the body weight of females is about twice that of males. Analyses of variance also suggested highly significant differences regarding body weight among full-sib groups, sexes and interaction in the data of both generations 12 and 13.

Heritability estimates from full-sib correlations of generations 12, 13 and 19 were 0.564, 0.474 and 0.515, respectively; however, these estimates were believed to be somewhat inflated because of the culturing methods employed. Heritability was also estimated from pooled regressions of offspring on male parent and on female parent; these estimates were 0.084 and 0.040, respectively. The difference between the offspring-parent covariances suggested the presence of a maternal effect.

Components of variance were estimated for paternal half-sib group, full-sib group, period of development, interactions and error by a least squares analysis of generation 19. The half-sib group components were found to be negative and various possible causes were mentioned.

Ten generations of selection for body weight at two intensities in each of two directions was accompanied by a definite, but highly variable, response. A total of fifty lines was initially included in the experiment, with ten replicates in each of five selection groups. The mean body weight of each line and group was presented for each generation of selection; in general, the mean body weight of the lines decreased with selection, except the group selected more intensively upward. This decline was attributed to inbreeding depression although some decrease in level of environment may also have occurred.

The divergence between the high and low selection groups was also presented in order to express the response on an intra-generation basis, thus avoiding inter-generation differences in environment and inbreeding. This divergence showed that a definite, but highly variable, response had occurred. A non-parametric test based upon the rank of the means indicated that a real difference existed between the selection groups when all generations were considered. A least squares method was employed to determine if any bias had resulted from the confounding of generation means with lines, but it was concluded that little or no bias was present in the previous results.

Inter-line and intra-line variance components were estimated each generation for each selection group; the magnitude of these components again emphasized the importance of random variation in a selection program in which the lines are perpetuated by only two parents. Curvilinear regressions of these components on generation number demonstrated that the components change as inbreeding and selection progress, but not always as expected.

Confidence intervals were calculated for lines selected alike and for the mean of selection groups. The latter intervals were smaller than the former and indicated that selection is more likely to result in progress in large populations than in small populations.

Microfilm $2.75; Xerox $5.20. 101 pages.

A STUDY OF THE CHROMOSOMES IN LEUKOCYTES FROM THE PERIPHERAL BLOOD OF CHILDREN WITH LEUKEMIA

(L. C. Card No. Mic 61-2040)

David A. Hungerford, Ph.D.
University of Pennsylvania, 1961

Supervisor: Jack Schultz

This investigation is one of a series designed to reveal whether visibly detectable changes are present in the chromosomes of leukemic cells in humans, and if there are to determine the types and specificity (if any) of such changes. Such questions are relevant to hypotheses which postulate that chromosome aberrations play a primary role in the etiology of malignancies.

Cited briefly are some of the technical advances in mammalian cytogenetics responsible in large measure for

the recent accelerated development of human cytogenetics. The major findings in human cytogenetics since the establishment in 1956 of 46 as the diploid chromosome number of man are reviewed briefly, and the Denver standard system for the morphological identification of specific human chromosomes and for their nomenclature is given in some detail. The methods for culture and cytological preparation of leukocytes from human peripheral blood are specified in full, as are the optical equipment and techniques used in examining the chromosomes. Some additional recognitional criteria for human chromosomes, which have come into use in this laboratory since the formulation of the Denver system are described.

A comprehensive review of publications to the time of writing (November 1, 1960) in the area of chromosomes in human leukemia is made, in which it is indicated that new and more thorough investigations are required, such as the present one, in which greater technical and experimental precision is employed.

Metaphase chromosomes in leukocytes from the peripheral blood of seven children with acute leukemia, and from the bone marrow of one of these children, were examined. A short-term (40 to 50 hours) culture method was employed. After treatment with colchicine to arrest mitoses at metaphase and after pretreatment in hypotonic saline to disrupt further the organization of the mitotic spindle, the cells were fixed (in absolute methanol:glacial acetic acid:: 3:1), air-dried on slides, and stained with acetic orcein. By the use of similar methods, the chromosomes of leukocytes from the peripheral blood of two non-leukemic children were examined.

In all of the leukemic children, the chromosome numbers were normal ($2n = 46$). Karyotype analyses were made on from five to fifteen metaphases in each case. In three children early in the course of the disease, and who had not been treated, the percentages of abnormal karyotypes were zero, 13, and 13. In a fourth child, also early in the course of the disease, who had been treated for only five days, 14 per cent of the karyotypes were abnormal. Two of the remaining children had been treated for three years, and had 20 and 27 per cent abnormal karyotypes; one child had been treated for six months and had 29 per cent abnormal karyotypes.

The chromosomes of the two non-leukemic children, one male and one female, both six years old, were normal in number. Ten karyotype analyses were done on each. All were normal. These data correspond well with the low frequency of aberrant metaphase chromosome constitutions observed earlier in the peripheral blood of non-leukemic adults (Nowell and Hungerford, J. Nat. Cancer Inst., 25: 85-109 (1960)).

The abnormalities in the chromosomes of the leukemic children showed no pattern of consistency; they were apparently random changes, and increased in frequency with duration of symptomatic disease and with therapy. Such changes are interpreted not to have a primary role in the etiology of childhood leukemia.

A comparison is possible with the results of an earlier investigation of granulocytic leukemia in adults (op. cit.). Two acute cases were found to have no significant departures from the normal in either chromosome number or morphology. However, in two chronic cases, while the number was normal, a minute chromosome was present in the stead of one normal chromosome. At that time, the normal chromosome replaced by the minute was interpreted as being either the Y (both cases were males) or one of the four (two pairs of) smallest autosomes. Subsequently, in a series of five additional cases (in both males and females) of chronic granulocytic leukemia investigated with better preparative techniques, the chromosome involved in this change was found to be one of the four smallest autosomes (Nowell and Hungerford, Science, 132: 1497 (1960)). The frequency with which this change is observed in chronic granulocytic leukemia and the specific nature of the change strongly suggest the existence of a relationship causal to the disease. The disparity between such findings and those in childhood leukemia reinforce the point of view which holds that a spectrum of causal mechanisms is likely to be involved in malignant disease, and particularly in leukemia.

Microfilm $2.75; Xerox $3.60. 64 pages.

A STUDY ON SOME ASPECTS OF LEPTOSPIRAL ANTIGENS AND ANTIBODIES

(L. C. Card No. Mic 61-1955)

Raymond Walter Lang, Ph.D.
Michigan State University, 1959

Major Professor: R. C. Ferguson

The leptospirae have been classified principally on the basis of antigenic relationships since the usual biochemical and morphological methods are of little or no value. Qualitative serological differentiation based upon antigenic characteristics of species has proved to be of tremendous aid, but even this method did not show sharp distinction among serotypes and considerable serologic cross agglutination is observed. Quantitative serological studies were conducted in the hope that this method would permit recognition of distinct antigenic differences among these organisms and thereby allow serologic classification without ambiguity.

Qualitative and quantitative examinations of L. icterohaemorrhagiae AB, L. canicola and L. pomona were conducted to ascertain the antigenic interrelationships. Before quantitative studies of the leptospiral antigen antibody system could be made, certain preliminary tests and standards had to be completed. Then, a study was conducted to determine the time, temperature and ratio of antigen to antibody necessary for complete adsorption of antibodies from antisera produced in rabbits. By using the proportion of antigen to antibody which agglutinated most rapidly in a series of mixtures, it was found that incubation at 37°C for 2 hours and 1°C over night resulted in complete adsorption of the antiserum.

Reciprocal cross agglutinin adsorption tests indicated that the three serotypes contain one antigen in common and that L. icterohaemorrhagiae AB contains two other antigens, one common to L. canicola and the other identical with a L. pomona antigen.

Quantitative estimations of the antibody nitrogen in antisera were made by two separate methods. With whole serum the amount of N in the antigen and the specific precipitate was determined by direct micro-Kjeldahl analysis. The difference between the two values equals the milligrams of antibody nitrogen precipitated. With purified

antibody solutions the amount of nitrogen in the supernatant fluid before and following adsorption was measured by the phenol reagent method and the difference in nitrogen was converted by an albumin standard to micro-Kjeldahl nitrogen. In the latter procedure the nitrogen of the antigen was obtained by converting optical density of the cell phenol reagent solution, by reference to a standard curve, into micro-Kjeldahl nitrogen.

A quantitative measure of the homologous antibody content of a serum and the amount of this antibody which combined with the two heterologous serotypes indicated that L. pomona is more similar antigenically to L. icterohaemorrhagiae AB than to L. canicola. The latter two species, however, are more closely related antigenically than L. pomona and either of the other two serotypes. The extent of cross reaction indicates a constant reciprocal antigenic relationship among the three serotypes.

A quantitative study of the combining ratio of antigen N to antibody N showed that the amount of antibody N precipitated was directly proportional to the amount of antigen N added. However, the combining ratios observed in the antibody excess zone was not described by the mathematical expressions derived for similar antigen antibody systems.

Since it was determined that formalin caused some change in the leptospiral cell which was observable by serological methods, relationships derived from these experiments with formalized antigens cannot be applied to these organisms in their natural state without qualification. A study of the agglutination test showed that the routine procedure of testing antisera produced significant error in the estimation of antibody. This work indicated the leptospiral cells contain more than one antigenic component and probably contain several antigens. Part of the cross reaction of these serotypes also might be explained by the presence of chemically related antigens. The results of qualitative examinations coupled with the reports of other workers, furnished sufficient information for the construction of probable antigenic structures for the serotypes studied as follows:

L. icterohaemorrhagiae AB	a (x, y), b, c . .
L. icterohaemorrhagiae A	a (x, y), b
L. canicola	a (x), c, d . . .
L. pomona	b, c, e . . . . .

By quantitative serological methods, it is possible to obtain confirmation of qualitative results and aid in interpretation of them. In this way a clearer insight into the antigenic interrelationships of these serotypes has been obtained. The study of many more serotypes by this combination of methods might reveal further interrelationships and eventually allow the construction of complete antigenic compositions for many of the members of the genus. Microfilm $2.75; Xerox $3.80. 67 pages.

CYTOLOGICAL AND INTERSPECIFIC HYBRIDIZATION STUDIES IN LILIUM L. AND THEIR SIGNIFICANCE FOR CLASSIFICATION.

(L. C. Card No. Mic 61-1433)

Richard William Lighty, Ph.D.
Cornell University, 1960

The presentation of a new classification of the genus Lilium by Comber in 1949 brought to an end the series of artificial classifications based on perianth position. This was the first major change in the classification of the genus since the time of Baker's 1871 revision. Despite Comber's use of many morphological and physiological characters in his classification it is felt to be in error in the placement of certain species. It is the purpose of the present study to assess the validity of Comber's schema through use of hybridization data and cytological information.

Forty-four species were pollinated in 443 interspecific combinations of which 126 produced some development of the ovary. These combinations were classified according to the amount of development produced. Numerical values were assigned the various amounts of development and weighted mean ratios obtained for each combination. The weighted mean ratio was designated the crossing coefficient and used to evaluate closeness of relationship. A schema of proposed phylogeny was presented on the basis of the crossing coefficient and found to be consistent with data on geographical distribution, morphological characters and karyotypes. The schema was compared with that presented by Comber and points of disparity noted and discussed. The agreement with Comber's classification was found to be close and few major alterations were proposed.

Karyotypes for Lilium distichum, L. hansonii, L. langkongense, L. nepalense, L. neilgherrense, L. medeoloides, L. macklininae, L. pomponium, L. pyrenaicum and L. wallichianum were prepared and presented as idiograms.

Karyotypes of all species of Lilium for which they were available were arranged according to the projected schema and changes with increased specialization were noted. The most obvious trend was seen to be a decrease in number of secondary constrictions correlated with advance in specialization. The similarity of karyotypes among closely related species was noted and considered evidence for the correctness of the arrangement.

During the preparation of the karyotypes large variation in the length of chromosome segments was noted. The total variation and the effects attributable to different cells and within cells were determined for identifiable chromosomes by an analysis of variance. The variation was found to obscure all but the most outstanding differences between non-homologous chromosomes in the complement. The L.S.D. test was applied to determine whether the gaps separating chromosomes of similar segment length were large enough to enable a worker to distinguish between them. It was found to be impossible, within acceptable levels of probability, to do so.

Somatic chromosome counts agreed with those previously published for all species examined.

A list of all hybrids reliably reported in the literature is presented with a summary chart giving the same information.

Pollen of lily species was found to be viable after six months storage in a dessicator at -20° and at 4°C.

Distribution maps for all species of Lilium were presented. Microfilm $2.75; Xerox $6.60. 136 pages.

CARBOHYDRATE TRANSPORT BY MAMMALIAN CELLS GROWN IN TISSUE CULTURE

(L. C. Card No. Mic 61-2102)

Joseph James Maio, Ph.D.
University of Washington, 1961

Chairman: H. V. Rickenberg

Experiments dealing with certain aspects of mammalian carbohydrate and amino acid transport are described. Earle's strain L-cells were selected for this study because they can be cultured in quantity as homogeneous populations of individual cells in suspension. The transport of D-galactose and alpha-amino isobutyric acid (AIBA) was studied since these compounds are not utilized by L-cells.

These investigations have shown that L-cells are unable to utilize galactose for growth or to respire this sugar: however, galactose exerted no toxic effect on the growth of these cells. Galactose was incompletely metabolized; consequently, galactose-1-phosphate and uridine diphosphogalactose accumulated intracellularly. The inability to utilize galactose for growth has been correlated with the absence of the enzyme, uridine diphosphogalactose-4-epimerase in this strain. The galactose-1-phosphate uridyl transferase activity of L-cell extracts was inhibited by galactose-1-phosphate (substrate inhibition). The significance of these findings and their possible bearing on the problem of human galactosemia are discussed.

The galactose transport mechanism is stereospecific as demonstrated by the occurrence of the phenomenon of competitive inhibition: it is also temperature and energy dependent. The intracellularly accumulated sugar (and its derivatives, galactose-1-phosphate and uridine diphosphogalactose) appeared to be in a state of dynamic equilibrium with the extracellular sugar. The kinetics of the uptake process followed an adsorption isotherm.

The efflux of previously accumulated galactose from the cells was not a simple diffusion process. Intracellularly accumulated galactose-1-phosphate and uridine diphosphogalactose could be converted to free galactose which appeared in the medium (it is believed that an acid phosphatase may have played some role in this process).

Glucose uptake paralleled galactose uptake in many respects; furthermore, galactose and glucose apparently share the same transport mechanism in L-cells. On the other hand, in Henle's human intestinal epithelial cells and also in HeLa cells, apparently different mechanisms mediate the transport of galactose and glucose, respectively.

Competitive inhibition experiments indicated that a sugar must have the galactose (or glucose) configuration at carbon atoms 1, 3 and 5 in order to have affinity for the L-cell hexose transport system. The other positions (carbon atoms 2, 4 and 6) could be altered without affecting the ability of the sugar to act as a competitive inhibitor of galactose uptake. K_m and K_i values for the competitive inhibition of galactose and glucose uptake by several other compounds are presented.

The mode of action of certain competitive inhibitors of galactose transport (e.g., phloridzin, phloretin, stilbestrol and progesterone) appeared to be quite different from the mode of action of sugars (e.g., glucose) which also competitively inhibited galactose uptake. Phloretin, stilbestrol and progesterone inhibited the formation of intracellular galactose derivatives in addition to inhibiting galactose transport. Furthermore, phloretin acted as a competitive inhibitor of AIBA uptake, and showed the same inhibition constant, $K_i = 3 \times 10^{-5}$ M, as that which characterized its inhibition of glucose and galactose uptake. Phloretin was also shown to be an inhibitor of L-cell ATPase. Neither galactose nor glucose inhibited AIBA uptake. These facts suggested that the amino acid and carbohydrate transport mechanisms of L-cells share an element in common which is directly related to the energy metabolism of the cell and which is not directly related to the fixation sites specific for amino acid and carbohydrates.

Microfilm $2.75; Xerox $7.80. 167 pages.

BOTANY

HETEROTHALLISM AND HOMOTHALLISM IN TWO MYXOMYCETES

(L. C. Card No. Mic 61-1915)

O'Neil Ray Collins, Ph.D.
State University of Iowa, 1961

Chairman: Professor C. J. Alexopoulos

Single spore studies of two Myxomycetes, Didymium iridis and Fuligo cinerea, revealed that the former is heterothallic while the latter is homothallic.

D. iridis: Two hundred and fifty-six single spore isolations were made from sporangia which developed in mass spore cultures. One hundred and one germinated, of which 22 yielded plasmodia that later fructified in most cases. The remaining 79 single spore cultures produced clones of myxamoebae and swarm cells only.

When 18 of the 79 clones were mated in all possible combinations, plasmodia developed in a pattern which showed that the clones were either (+) or (-) with regard to mating type. Fructifications were readily obtained from these plasmodia.

Fifty-three single spores of the F_1 generation were

isolated. Of the 44 that germinated, 9 yielded plasmodia in monospore cultures, and 35 produced clones of myxamoebae and swarm cells only. Twenty-five of the F_1 clones were back crossed with their parents. Results of the back crosses show that each F_1 clone is capable of yielding plasmodia with either the (+) or the (-) parent, never with both. When 14 of the F_1 clones were mated among themselves a (+/-) mating type system was again revealed.

It was pointed out above that 22 of the original single spore cultures produced plasmodia which, in most cases, later fructified. From these sporangia, 88 spores were isolated. Seventy-two of these germinated and yielded large populations of swarm cells and myxamoebae, but none produced plasmodia. Twenty of the 72 clones were then mated among themselves. Some matings resulted in plasmodial formation, but the pattern was difficult to interpret. However, when these twenty clones were mated with known (+) and (-) clones, the results appear to be in keeping with a (+/-) mating type system.

F. cinerea: Two hundred and nineteen single spores of F. cinerea were isolated from aethalia derived from mass spore cultures. One hundred and forty-four germinated and the same number yielded plasmodia. Fructifications were easily obtained from such plasmodia.

Thirty-five second generation single spores were isolated, of which 15 germinated and 15 yielded plasmodia. These results indicate that F. cinerea is homothallic.

Microfilm $2.75; Xerox $3.00. 46 pages.

INVESTIGATIONS ON THE PHYSIOLOGY OF THE BLACK KNOT DISEASE OF CHERRY

(L. C. Card No. Mic 61-1742)

George Linden Greene, Ph.D.
University of Michigan, 1961

A study of the black knot disease of several species of cherry was undertaken in an effort to determine the physiological basis for the formation of the tumors which characterize this malady. The approach used was based on the theory that the pathogen, Dibotryon morbosum, was capable of producing growth substances within the tissues of the host, and that these substances could induce neoplastic growth.

Several strains of the parasite were isolated by single spore technique from naturally infected host material. These strains were maintained on potato-dextrose agar, and studied in "shake cultures" in a medium designed to satisfy the nutritional requirements of the fungus. It was found that the particular strains studied required an organic source of nitrogen, and this was supplied in the form of casein hydrolysate. The optimum pH was determined to be 3.7.

After the nutritional requirements of the fungus had been determined, "shake cultures" were prepared and harvested after a period of 10 days. The culture filtrate was extracted in the cold in peroxide-free diethyl ether. This extract was then spotted onto 1 inch wide strips of Whatman #1 filter paper and chromatographed in special tubes using a solvent system composed of isopropanol:ammonia:water (10:1:1). The chromatograms were scanned under ultra-violet light (254 mμ) and the absorbing or fluorescing spots marked and the R_f values recorded. The strips were then assayed for growth substances using the Avena first internode bioassay. Several Avena-active materials were found, one of which was determined by the R_f value and reaction with certain color reagents to be indoleacetic acid. The chemical identity of the other substance was not determined, but it is suspected of being nonindolic. By the use of ultra-violet spectrophotometric procedures it was determined that a presumptive purine or pyrimidine was also present in the ether extract.

Once it had been ascertained that the pathogen was indeed capable of producing growth substances in vitro, further experimentation was performed to determine the effect of these substances and other known growth substances on the tissues of the host. When these materials were suspended in lanolin paste and smeared on the intact host plants, it was observed that of all the compounds studied including those produced by the fungus, only 2,4-D could induce neoplastic growth. Histological investigations showed that this abnormal growth was due to increased cambial cell division, and not to a combination of cell division and cell enlargement such as occurs in naturally infected hosts.

The in situ experiments mentioned above have several drawbacks, and to overcome these another bioassay using host material was designed. This was the Prunus disc test in which small segments of green cherry twigs were placed on small paper discs which were saturated with White's medium and the growth substance to be investigated. The results of these experiments showed that IAA could induce cell enlargement and that the ether extracts of the culture filtrate could induce both cell division and cell enlargement.

It was concluded from these experiments that the fungus could produce both a cell division factor, which is as yet unidentified, and a cell enlargement factor, which is suspected to be indoleacetic acid.

A series of experiments was also run to study the presence, if any, of polyphenol oxidases in the culture filtrate and in the host tissue. It was determined that these are present in both places, and that they are capable of oxidizing catechol but not tyrosine.

Microfilm $2.75; Xerox $5.20. 105 pages.

STUDIES IN THE GENUS NECTRIA

(L. C. Card No. Mic 61-1745)

Richard Thomas Hanlin, Ph.D.
University of Michigan, 1961

Studies were conducted to determine the pattern of ascocarp development and some of the factors affecting fruiting in Nectria gliocladioides Smalley and Hansen, N. ipomoeae Halsted, and N. peziza (Tode) Fries.

All three species studied fruited best at a temperature of 24°C. The length of time required for fruiting varied greatly depending upon the medium used. Light was found to be necessary for perithecial production in N. gliocladioides and N. peziza, but N. ipomoeae fruited normally

in total darkness. N. gliocladioides and N. ipomoeae are capable of digesting starch, but N. peziza lacks this ability.

Cultures of N. gliocladioides with and without a basal stroma could be obtained by varying the substrate. Therefore this character is considered too variable to be of taxonomic value.

Ascocarp development in N. gliocladioides is sphaeriaceous in nature, with a centrum possessing downward-growing pseudoparaphyses. There is a true perithecial wall surrounded by a stromal layer. This species conforms to the Nectria-type of development of Luttrell.

Nectria ipomoeae also has a sphaeriaceous pattern of development, but differs in that it has no pseudoparaphyses and possesses a pseudoparenchymatous centrum into which the asci grow. The perithecial wall is pseudoparenchymatous; there is no stroma surrounding it. This species falls under the Diaporthe-type of development of Luttrell.

Nectria peziza has a pattern of development similar to that of N. ipomoeae.

The discovery of two distinct developmental patterns within the genus Nectria suggests that this genus should be divided. However, before this can be done many more species must be studied to determine exactly the extent of these patterns within the genus.

Microfilm $2.75; Xerox $5.60. 114 pages.

ONTOGENY AND EMBRYOLOGY IN MERTENSIA

(L. C. Card No. Mic 61-2086)

Pushpa Khanna, Ph.D.
University of Oregon, 1961

Adviser: Sanford S. Tepper

Mertensia is a perennial herb. Material of Mertensia platphylla was collected from Armitage Park, near Eugene, Oregon, and M. paniculata from Mule Prairie near Willamette Pass, Oregon. It was fixed in formalin-propionic-ethanol. Sections were cut varying from 8 microns to 10 microns in thickness. The slides were stained with the Foster or safranin and fast green stains.

The shoot apex consists of two tunica layers and a corpus. The corpus region has well marked central and peripheral zones. The shoot apex produces in turn, bud scales, foliage leaves, bracts and floral appendages. In the transition from vegetative to flowering condition, the apex becomes more elongate and wider; the cells in the corpus become vacuolated. Petals and stamens arise at the same level from a ring-like base. The corolla is differentiated into three parts, lower corolla tube, upper corolla tube and free lobes. After the production of carpels the apex ceases to function.

The early ontogeny of all appendages is the same. Initiation results from periclinal divisions in the second tunica layer high on the flank followed by divisions in the outer corpus layers below. The laminae of leaves and bracts grow by marginal meristems. Radial growth results from activity of an adaxial meristem.

The lower corolla tube is formed by meristematic activity at the base, while the upper corolla tube is formed by ontogenetic fusion of the marginal cells of the adjacent petals.

The two carpels grow by meristematic activity of the ring-like base below and a cylinder is formed. At first the ovary is unilocular, becoming four-parted later through the formation of placentae and false septa. The ovary remains unilocular at the base until the nutlets are formed. Each locule has one ovule. By fusion of the adaxial carpel surfaces above the ovary, the style is formed. The style is two-cleft at the top. It remains four-flanged at the base with a cavity.

The stamens grow faster than the petals. The filament of the stamen is formed by the adaxial meristem. The anther is four-lobed. Each lobe is surrounded by an epidermis, middle layer, endothecium and tapetum. Each lobe is separated from the adjacent lobe by a group of thin-walled cells. The anther dehisces at this point. Pollen is shed at the 3-celled stage.

The ovule is unitegmic and tenuinucellate. The archesporial cell directly functions as the megaspore mother cell. Two archesporial cells in M. platyphylla have been observed occasionally. Four megaspores are formed by meiosis in the megaspore mother cell. The chalazal megaspore functions to give rise to an eight-nucleate Polygonum type embryo sac. Fertilization was observed. The nucellus cells at the base become cutinized to form a hypostase. The endosperm is nuclear at first, becoming cellular later.

The zygote divides transversely and both apical and basal cells produced take part in the formation of the embryo. A clear zonation of radicle and epicotyl regions was seen in mature embryos.

Microfilm $2.75; Xerox $6.40. 131 pages.

LIGHT-CONTROLLED REPRODUCTIVE DIFFERENTIATION IN ASPERGILLUS ORNATUS

(L. C. Card No. Mic 61-1782)

Donald Jack Schwemmin, Ph.D.
University of Michigan, 1961

The mold Aspergillus ornatus was studied with respect to asexual and sexual patterns of differentiation. On a complex medium, the reproductive response was determined by the light environment. Illuminated cultures produced abundant conidia, but in the dark the conidial phase was absent and perithecia developed. Measurement of growth in the light and dark revealed that dark-grown cultures always synthesized approximately twice as much dry matter as light-grown cultures after one week of incubation. Linear extension of mycelium and utilization of glucose were also reduced in illuminated cultures. Limitation of the glucose available to the dark-grown mycelium resulted in the formation of conidia in the absence of light.

All areas of a dark-grown colony were not equally sensitive to light. When a colony was exposed for 4 hours and returned to darkness, conidiophores and conidia developed in a ring a short distance from the periphery of the colony. Examination of an exposed colony under ultraviolet light before the appearance of conidia, revealed a ring of red-fluorescence in the approximate position where conidia would be formed. This red-fluorescent material could be extracted from the mycelium with dioxane and possessed a single absorption maximum at 380 mμ. Light exposures

which would induce conidiation always induced the formation of the red-fluorescent pigment.

A cell-free extract prepared from illuminated mycelium would not induce formation of conidia when added to dark-grown cultures. However, this extract did inhibit the growth of mycelium in the dark. A similar extract prepared from dark-grown mycelium was observed to inhibit conidiation in the light, apparently without inhibiting growth of the mycelium.

When the mold was cultivated on a synthetic glucose, ammonium tartrate medium, the light-dark response was absent in that conidia were formed in both the light and dark. The light-dark response was regained when casein hydrolysate was added to the basal medium. Out of twenty-five amino acids tested, only L-tyrosine consistently inhibited conidial formation in the dark. The addition of tyrosine also stimulated growth in the dark more than growth in the light.

The free-amino acid pool of mycelium was examined chromatographically before and after light exposure. There seemed to be a depletion of all amino acid components after illumination. The pool from mature conidia was different from that of mycelium.

Mutant strains were obtained which produced conidia in either the light or dark. The wild-type response was observed in colonies originating from a mixture of conidia. Only two of the five strains were capable of forming a presumptive heterocaryon with a wild-phenotype.

A model is proposed to explain the means by which light controls the sexual and asexual pathways of reproductive differentiation.

Microfilm $2.75; Xerox $5.40. 106 pages.

ASSAY OF WOUND-TUMOR SOLUBLE ANTIGEN IN EXTRACTS FROM SINGLE INSECT VECTORS AND FROM GROUPS OF VECTORS

(L. C. Card No. Mic 61-1679)

Robert Franklin Whitcomb, Ph.D.
University of Illinois, 1961

Methods for preparation and assay of wound-tumor soluble antigen (WTSA) in ultracentrifugally clarified extracts were refined. Specially designed adapters for ultracentrifugation permitted preparation of volumes of extract as small as .05 ml. Absolute WTSA titers were determined by the precipitin ring endpoint method, using dilution factors as low as 1.3. Relative titers were obtained by comparison of precipitin ring time curves of dilution series. The error of this time test was experimentally determined, and found to average 7%.

The synthesis, or "growth curve" of WTSA as a function of time in days after injection of massive doses of wound-tumor virus was found to rise steeply, attaining a plateau level after 8-10 days. The "transmission curve," reflecting average inoculativity of the group of injected insects as a function of time in days after injection, attained a maximum about 35 days after injection, then dropped slowly.

Analyses of single infected vectors showed that in the growth curve experiments, nearly all injected insects supported WTSA synthesis. No insects negative for WTSA were found to transmit WTV to plants, but a number of insects positive for WTSA failed to transmit. The WTSA titer of single insects was found to agree with the average titer obtained from extracts of groups of vectors.

It was found possible to accurately estimate proportions of infected vectors by grinding insect samples en masse and by obtaining the WTSA titer of the mass extract. Relative proportions could be estimated by the time test. These two methods were then combined to score vectors infected in an assay experiment. The length of time required, for the assay which previously required nine weeks, was shortened to less than three weeks.

Microfilm $2.75; Xerox $3.00. 48 pages.

EFFECTS OF TISSUE EXTRACTS ON THE GROWTH OF INTACT ROOTS

(L. C. Card No. Mic 61-1941)

Derrell Bruce White, Ph.D.
State University of Iowa, 1961

Chairman: Associate Professor Robert M. Muir

Roots of Pisum sativum variety Alaska were used in this investigation. Seeds were imbibed 24 hours and germinated between glass plates for 48 hours. Eighty-five to 100 seedlings were selected and placed in each culture vessel used. At each 24 hour interval of the 5 day growth period, 15 seedlings were removed from culture, and the length of the root and epicotyl determined to the closest millimeter.

The culture vessels had a volume of 2.5 liters and were of ordinary glass. Each vessel was fitted with a 1/4 inch mesh wire grid suspended about one inch below the rim of the vessel. Cotyledons of the seedlings rested on the grid and the roots projected through the grid into the culture solution.

Aqueous extracts of Lathyrus odoratus seeds and the lemma and palea of Avena sativa were added as desired to the culture solutions. Growth of pea seedlings in these solutions was compared with growth in Knop's nutrient solution, Knop's solution plus micronutrients, Knop's minus potassium solution, 0.001 Molar KCl, 0.001 Molar NaCl and gibberellic acid solutions to two concentrations, 2.5×10^{-5} Molar and 5.0×10^{-5} Molar. Seedlings were grown in Pyrex redistilled water as controls.

Root growth was stimulated by Lathyrus odoratus extract and Avena sativa lemma and palea extract. The growth rate increased at each 24 hour interval throughout the growth period. Roots growing in Pyrex redistilled water characteristically exhibited a steady decline in growth rate.

Roots growing in Knop's nutrient solution and Knop's solution plus micronutrients maintained their initial growth rate during the growth period. Knop's minus potassium solution inhibited root growth temporarily but some roots were able to overcome the inhibition after about 72 hours.

Root growth is not stimulated by 0.001 Molar KCl or 0.001 Molar NaCl. The growth rate is steady throughout the growing period but the rate is less than that of roots growing in Knop's solution.

Gibberellic acid, in both concentrations used, failed to

stimulate root growth. Near the end of the growth period, the growth rate of roots tended to decline but the steady decline characteristic of roots growing in water was not evident.

Measurement of median longitudinal sections through the apical meristem reveals that the meristematic zone of roots growing in Lathyrus odoratus extract culture solution increases in size during the growth period. On the other hand, the meristematic zone of roots growing in water and Knop's solution decreases.

Epicotyl elongation was stimulated by Lathyrus odoratus extract, Avena sativa lemma and palea extract, Knop's nutrient solution, Knop's solution plus micronutrients and both gibberellic acid culture solutions. Knop's minus potassium solution inhibited epicotyl growth for about 96 hours but some of the epicotyls were able to overcome the inhibition after this time. Epicotyls of plants growing in 0.001 Molar KCl and 0.001 Molar NaCl were only slightly longer than those of plants growing in Pyrex redistilled water at the end of the growth period.

Use of the aqueous extract of the lemma and palea of Avena sativa in the Avena straight growth test indicated that the extract has no effect on cell elongation.

Chromatographs of Lathyrus odoratus extract and Avena sativa lemma and palea extract and the extracts themselves were tested for the presence of gibberellic acid, indoleacetic acid, coumarin and kinetin. There was no indication that any of these substances were present in the extracts.

Some differences in germination and early growth of two varieties of Pisum sativum, Alaska and Little Marvel, a dwarf variety, are illustrated and discussed.

The material present in Lathyrus odoratus extract and Avena sativa lemma and palea extract which is responsible for the stimulation of root growth was not identified.

Microfilm $2.75; Xerox $6.20. 128 pages.

VARIATION OF THREE TAXONOMIC COMPLEXES OF THE GENUS CORNUS IN EASTERN UNITED STATES

(L. C. Card No. Mic 61-1812)

James Stewart Wilson, Ph.D.
University of Michigan, 1961

This work represents a detailed study of six closely related taxa of Cornus (dogwoods) in eastern United States. These taxa have been treated by most botanists as C. foemina, C. racemosa, and C. microcarpa (treated here as a single species, C. foemina, with three subspecies); C. amomum and C. obliqua (treated here as a single species, C. amomum with two subspecies); and C. drummondii.

The aims have been fourfold: to distinguish between the species, as all plants are grossly similar and the characters separating them are subtle; to evaluate the effects of habitat and distribution upon variation and speciation; to determine what effects hybridization has had upon variation; and to present a formal treatment expressing the interrelations of the taxa, discussions of their nomenclature and geographical distribution, and a key for identification.

A considerable amount of field study was carried out, both in the northern and southern parts of their ranges, with special emphasis upon the effects of habitat (especially open and shaded habitats) and hybridization upon the variation. In addition to the field studies, 4,500 herbarium specimens were examined. From personal collections and herbarium specimens, detailed studies were made of various morphological and anatomical characters such as leaf epidermis, venation, and pubescence; young twig characteristics; floral morphology; and pollen. Where it was feasible, certain of these characters were analyzed statistically. The evidence from the investigations supported in general a concept of three rather than six species, two of the species made up of subspecies.

Habitat, glaciation, and geographical distribution have apparently been important factors in variation in these species of Cornus. Two subspecies, C. foemina subsp. racemosa and C. amomum subsp. obliqua, probably migrated northward from their parental stocks into the new habitats created by glaciation.

Today, in regions of overlap, frequent hybrids are formed between these taxa. Intraspecific hybrids, in contrast to interspecific hybrids, are usually more common and have no substantial increase in pollen inviability over that in normal species, while the latter usually are characterized by a considerably higher degree of pollen inviability.

Evidence from studies of morphology, habitat, ecology, geography, and hybridization necessitated a taxonomic revision of the groups involved. This revision is presented with keys to the species and subspecies, followed by lists of the more important synonyms, descriptions, discussions, and lists of specimens examined for each. The putative hybrids are also described, and pertinent notes given on their occurrence and identification.

Microfilm $2.75; Xerox $8.00. 171 pages.

CHEMISTRY, ANALYTICAL

NEUTRON ACTIVATION ANALYSIS BY MEANS OF SHORT-LIVED ISOTOPES

(L. C. Card No. Mic 61-1723)

James Lawton Brownlee, Jr., Ph.D.
University of Michigan, 1961

The purpose of this research was to evaluate the application of short-lived isotopes to analysis by radioactivation and to develop rapid chemical separations of several short-lived isotopes from a variety of sample matrices. Radioactive tracer methods were used to determine the extent of chemical recovery following separation of vanadium-52, thallium-206 and niobium-94m. These isotopes were chosen as being representative of beta and gamma emitters, pure beta emitters and x-ray emitters, respectively. Special instrumentation, in the form of a dual memory 100-channel pulse height analyzer, was used and evaluated for the analysis of the beta and gamma radiation of counting samples.

Determinations were made of the amount of vanadium, as 3.7-minute vanadium-52, in a series of petroleum process stream samples which included distillation residues and condensates. Samples from various refinery streams were sealed in polyethylene tubing for irradiation in the reactor. It was found that the vanadium in these samples could be determined non-destructively by gamma spectrometry of the irradiated gross samples. Determinations of vanadium in samples of petroleum cracking catalyst required chemical separation of the vanadium prior to gamma spectrometry because of interference from the photopeak of aluminum-28. A rapid separation of vanadium from aluminum and silicon was developed, employing solvent extraction of vanadium cupferrate into chloroform. This extraction followed fusion of the sample with sodium peroxide and removal of aluminum with 8-hydroxyquinoline. The chloroform solution of vanadium cupferrate was used for gamma analysis. This separation, requiring approximately 9-1/2 minutes, has been used to separate vanadium from several types of samples.

Determinations of vanadium made on the petroleum samples containing 10^{-6} to 10^{-7} grams of vanadium per gram of sample, showed standard deviations of 10-percent or less. Determinations of vanadium in cracking catalyst samples showed a higher standard deviation.

Determination of thallium, as 4.2-minute thallium-206, was performed on rock and mineral samples. Thallium-206, being a pure beta emitter, was determined by decay curve resolution on separated thallium fractions. Several procedures were investigated for the chemical separation of thallium. Fusion and extraction of bromothallic acid into isopropyl ether were common to all procedures. Following extraction and evaporation of the ether, thallium(I) was precipitated as the iodide, the tetraphenylboron salt, or as the thionalide complex. These procedures were evaluated and used in the determination of microgram amounts of thallium in rock samples. Results show that amounts of thallium down to the order of 10^{-7} grams can be determined as thallium-206.

Niobium was investigated by means of its K x-ray, emitted in the decay of 6.6-minute niobium-94m. Detection was achieved by means of a sodium iodide (thallium) scintillation detector, a krypton-filled x-ray proportional counter having proved to be of little use for quantitative work.

Several separation procedures were investigated for the post-irradiation separation of niobium from a variety of samples; only limited success was realized. Adsorption of niobium radiocolloid on silica gel showed chemical recovery of 30 - 35 percent from rutile samples, but could be applied only to samples containing little or no silica. A pre-irradiation separation of niobium by paper chromatography was investigated and found to offer certain advantages over other methods.

Microfilm $2.90; Xerox $10.15. 221 pages.

PART I. KINETIC AND THERMODYNAMIC STUDIES OF THE HYDROLYSIS AND ALCOHOLYSIS OF ACETALS BY GAS CHROMATOGRAPHY. PART II. DETERMINATION OF CARBON IN ORGANIC SUBSTANCES BY AN OXYGEN-FLASK METHOD.

(L. C. Card No. Mic 61-1601)

Jen Chiu, Ph.D.
University of Illinois, 1961

Gas chromatographic techniques have been developed to study the kinetics and thermodynamics of the acid-catalyzed hydrolysis and alcoholysis of aliphatic acetals.

The mechanism of the acid-catalyzed hydrolysis of acetals has been reviewed. The reaction proceeds according to a unimolecular mechanism. The rate-determining step is the formation of an aldehyde carbonium ion from the conjugate acid of the acetal. The reaction mixture was analyzed by a gas chromatographic column made from 9 feet of 1/4-inch copper tubing packed with 48 parts of 40% w/w Carbowax 1000 on Celite 545 (100/150-mesh) and 52 parts of 40% w/w Polyglycol P-2000 on Celite 545 (100/150-mesh). The column was operated isothermally at 110° with a constant helium flow of ca. 40 ml./min. (room temperature and atmospheric pressure). The equilibrium constant in terms of mole fractions for the formation of diethyl propylal was found to be 1.24 ± 0.03 at 25.0° and 1.90 ± 0.03 at 0°. From standard free energy changes at 25.0° and 0°, the standard enthalpy

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

change and the standard entropy change of diethyl propylal formation have been calculated to be -2.76 Kcal. and -8.84 e.u., respectively. The rate of hydrolysis of diethyl propylal was determined by following the appearance of gas chromatographic peaks of propionaldehyde, ethanol and diethyl propylal during the course of the reaction. The rate of the reaction was found to be first order in both the acetal and the acid catalyst concentrations. Rate constants have been determined in three different reaction media ranging from 70.0 to 87.8 per cent by volume aqueous dioxane. A rate-solvent composition curve has been constructed from these results together with two literature values. The rate decreases with increasing dioxane concentration and goes through a minimum. Possible interpretations of this minimum have been discussed.

The two-step, acid-catalyzed methanolysis of diethyl acetal has been investigated by gas chromatography. The column was 9 feet long and was made from 1/4-inch copper tubing packed with 30% w/w di-octyl phthalate on 80/100-mesh Johns-Manville acid-washed Chromosorb-W. A column temperature of 80° was used for equilibrium studies and 97° for kinetic studies. Helium was used as the carrier gas with a constant flow rate of ca. 40 ml./min. (room temperature and atmospheric pressure). The reaction proceeds by two consecutive reversible first order reactions corresponding to the stepwise exchange of the acetal ethoxy groups. The rate of both steps shows first order dependence on acid concentration and is independent of alcohol concentration. Gas chromatography is shown to be ideally suited for choosing the reaction period for maximum yield of stable intermediates in consecutive reactions. The equilibrium constants for both of the two consecutive reactions were determined simultaneously from the concentrations of the five components in the equilibrium mixture and are equal to 4.65 ± 0.09 and 1.01 ± 0.04, respectively. From reaction rates measured as a function of temperature, Arrhenius energies of activation of the two reactions were calculated to be 18.1 ± 0.4 and 19.6 ± 0.9 Kcal./mole, respectively. Accordingly, enthalpies and entropies of activation were found to be 17.5 Kcal./mole and -16.3 cal./mole-deg. for the first step of the methanolysis and 19.0 Kcal./mole and -11.1 cal./mole-deg. for the second step of the reaction. A mechanism analogous to that of the hydrolysis reaction is proposed. No previous thermodynamic or kinetic studies on the alcoholysis of acetals have been reported because of the lack of a suitable analytical method.

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Carbon in organic substances has been determined by electrical ignition in an oxygen-filled flask. The carbon dioxide evolved is absorbed in aqueous sodium hydroxide and determined by titration with acid. A mean absolute deviation of 0.3% from the true value has been obtained for a variety of compounds. No expensive apparatus is required. A complete determination, excluding the time required to weigh the sample, may be made in less than 20 minutes. Organic compounds containing nitrogen, sulfur, boron and alkali metals are readily analyzed. Unsatisfactory results were obtained for halogen compounds such as 2-chlorobenzoic acid and 2-iodobenzoic acid. Complete combustion was not achieved with sodium oxalate. Microfilm $2.75; Xerox $6.40. 132 pages.

PART I. THE CADMIUM N-METHYL GLUCAMINE SYSTEM. PART II. SPECIFIC ADSORBENTS IN GAS CHROMATOGRAPHY.

(L. C. Card No. Mic 61-162)

Charles Theodore Lynch, Ph.D.
University of Illinois, 1960

The complexes formed by cadmium and N-methylglucamine have been studied by several complementary techniques: polarimetry, potentiometry, polarography, amperometry, and absorptiometry.

No complexes are formed below pH 8.8. Between pH 6.5 and 8.8 cadmium hydroxide is formed. In the pH region between 8.8 and 13.0 a 3:2 cadmium to N-methylglucamine complex is formed. The region is characterized by very slow equilibrium. At a pH of 9.5 optical rotation studies provide evidence that a soluble 1:4 species is formed. At a pH of 10 and 11 a soluble 1:2 species was found. At a pH of 11 after the solutions have equilibrated one week, 3:2 and 2:1 species appear to be formed. After one month's standing, evidence is presented for the existence of 1:2 and 4:1 species. The 3:2 complex which predominates in the pH 8.8 to 13.0 region consumes 3 hydroxides per N-methylglucamine in complex formation. All solutions containing more than 25 mole % cadmium at a pH of 9.5 to 11 had a precipitate. The precipitate obtained at 50 mole % cadmium contained 11% of the total cadmium added in preparing the solution. The precipitate analyzed as $NaCd(OH)_3 \cdot Cd_3(C_7H_{14}O_5N)_2$. Above a pH of 13.0 no complexes are formed unless N-methylglucamine is present in large excess.

Two polarographic waves were found in solutions 0.50 M to 2.00 M in sodium hydroxide. The first wave is a reversible two-electron reduction of a 1:1 complex. Two hydroxide ions are consumed per cadmium ion in the formation of this complex. The pK values of the complex are: 9.62, μ = 2.0; 9.41, μ = 1.5; 9.23, μ = 1.0; 9.00, μ = 0.5. In 1.00 M sodium hydroxide and 0.100 M N-methylglucamine $(E_{\frac{1}{2}})_{c1:1}$ = -0.820 v. vs. S.C.E. The second wave is an irreversible adsorption wave between -1.00 and -1.50 v. vs. S.C.E. Amperometric titrations confirm the 1:1 complex for the first wave.

In the solutions that do not contain an excess of N-methylglucamine (e.g. 0.050 M cadmium nitrate and 0.050 M N-methylglucamine) the complexes decompose rapidly to give cadmium hydroxide and free N-methylglucamine.

An all-metal gas chromatography apparatus using thermistors and an isolated reference cell and a glass hot-wire cell for use with an all-glass instrument are described.

The preparation of specific adsorbents as column materials for gas chromatography has been studied. Specific adsorbents were prepared by occluding organic substances in silica gel. The occluded phase was removed by heat or extraction. The conditions of preparation of the gel and removal of the occluded phase have been examined. The extraction of the occluded phase was the better method. The extraction step did not introduce any specificity into the gel for the extracting agent. The retention volumes for n-alcohols, sec-alcohols, and acetates of n-alcohols have been compared for gels prepared with an

occluded substance, and gels prepared without an occluded substance. Adsorbents have been prepared that show considerable specificity for sec-pentanol. The greatest change in retention volume observed for sec-pentanol was about 50 per cent. Adsorbents prepared with n-butanol and n-propyl acetate were not specific. An adsorbent prepared with ethyl acetate irreversibly adsorbed ethyl acetate.

The resolution of sec-alconols on a number of optically-active adsorbents and optically-active liquid phases has been investigated. The results were negative with the possible exception of a partial resolution of sec-hexanol on a d-tartaric acid adsorption column.

Microfilm $2.75; Xerox $6.80. 144 pages.

THE RATE OF OXIDATION AND CHANGES IN THE SURFACE ACTIVITY OF PLATINUM ELECTRODES

(L. C. Card No. Mic 61-1332)

James Graham Smith, Jr., Ph.D.
University of Washington, 1960

Chairman: Dr. A. L. Crittenden

A current integrator and electronic timer have been used to obtain precise measurements of the charge transferred at a platinum microelectrode when fixed potentials are applied from an external source. An electronic potentiostat was employed to compensate for the potential (IR) drop through the solution.

The surface oxides are shown to be stable for at least 2 minutes at open circuit and for periods up to 10 minutes at +1.00v, when formed at the higher potential of +1.40.

Values for the capacitance of the electrical double layer, used as a correction for observed charges, were estimated in two ways. One method was to observe the charge transferred for incremental potential changes and the other was from the slope of the oxide reduction curve in a potential region where the oxide is stable.

Activity changes of the electrode surface are proposed to be caused both by the changes in the true surface area of the electrode and by distortion of the metal lattice. Hydrogen is shown to cause irrevocable changes.

Evidence is presented to show that oxidation of a platinum electrode is actually related to the reverse step of oxygen reduction and that oxygen evolution possibly takes place on a monolayer of PtO. It is also proposed that when the quantity of oxide on the electrode surface approaches that required for a monolayer of PtO_2, forces of crystallization for the oxide becomes significant and when the lattice forces have been weakened by the presence of hydrogen in the metal, a surface rearrangement takes place.

Rates of oxide reduction are shown to be negligible at +1.00v and above, but increase almost exponentially below this value. Microfilm $2.75; Xerox $4.00. 71 pages.

TRENDS IN THE STABILITIES OF SOME RARE EARTH CHELATES

(L. C. Card No. Mic 61-1586)

Albert Stephen Tompa, Ph.D.
Fordham University, 1961

Mentor: Michael Cefola, Ph.D.

This investigation involved a potentiometric study of the chelates formed by the cerium group of rare earth chlorides (lanthanum, cerium, praseodymium and neodymium) with several types of organic compounds, including the amino, hydroxy and mercapto analogs of acetic, propionic, benzoic, and succinic acid.

The experimental procedure involved a potentiometric titration of the organic acids in the absence and presence of the rare earth chlorides. For each organic acid, a titration was carried out using 1:1, 3:1, and 12:1 ratios for acid to metal ion concentration. The ionic strength of the solutions in all cases was adjusted to 0.1 using potassium chloride as a supporting electrolyte. During titrations the cell was immersed in a constant temperature bath maintained at 30° C. In addition, several lanthanide chelates were prepared so that the analysis of their infrared spectra might supply additional supporting evidence for the structures proposed from the potentiometric studies.

The over-all order of decreasing stability for the ligands studied was aspartic, malic, thiomalic, glycine, glycolic, anthranilic, salicylic, β-alanine, β-hydroxy propionic, β-mercapto propionic, and thioglycolic acid. From this order it may be seen that the lanthanide chelates of the amino acids are the most stable, followed by the chelates of the hydroxy acids, and finally the mercapto acids. With the series of metal ions studied, the stability was found to increase in the order, lanthanum, cerium, praseodymium and neodymium.

The following conclusions were reached:

(1) The stability of the chelates with the analogs of acetic, propionic, benzoic, and succinic acid decreased as the donor group changed from $-NH_2$ to -OH to -SH. This was found to parallel the order of decreasing basicity in any given series.

(2) The amino and hydroxy analogs of acetic acid were more stable than the corresponding analogs of propionic acid. This was attributed to the fact that five-membered ring chelates are usually more stable than six-membered.

(3) The mercapto analog of propionic acid was found to be more stable than the mercapto analog of acetic acid. This was attributed to steric factors involving both the metal ion and coordinating group.

(4) The analogs of benzoic acid were more stable than the corresponding analogs of propionic acid. This was attributed to resonance and steric factors inherent in the aromatic ring.

(5) The analogs of succinic acid were found to form the most stable chelates. This was attributed to the formation of tridentate chelates.

(6) The tendency to form double-ring chelates was

found to be almost as strong as that to form single-ringed chelates.

(7) The trends in stability with the series of metal ions can be correlated with the various effects accompanying an increase in atomic number in this series.

(8) Infrared spectra indicated that both the donor group and carboxylic acid group are affected by chelate formation. This supplied additional evidence for the structures proposed.

On the basis of the experimental data, possible mechanisms were postulated for acid dissociations and chelate formation. Microfilm $2.75; Xerox $4.40. 81 pages.

PART I: THE PALLADIUM ELECTRODE IN AQUEOUS AND NON-AQUEOUS TITRIMETRY. PART II: THE POLAROGRAPHY OF THE QUINOLINE-MONOCARBOXYLIC ACIDS.

(L. C. Card No. Mic 60-5263)

Theodore Roosevelt Williams, Jr., Ph.D.
The University of Connecticut, 1960

PART I.

This research was initiated in an attempt to develop an electrode useful for aqueous and non-aqueous titrations. Two modifications of the palladium-hydrogen electrode previously employed by Schwing and Rogers were made and tested. The change of potential of these electrodes with time was observed in a series of buffer solutions. A new form of "generation" electrode with a vertical palladium diaphragm and fast, constant speed circulation was devised. This vertical electrode design gave more satisfactory response than the two electrodes first tested in this study. Since this electrode responded rapidly, it was used in a variety of acid-base titrations in aqueous and non-aqueous systems.

PART II.

The polarographic behavior of quinoline-3, -5, -6 and -7-carboxylic acids has been investigated in a series of well-buffered solutions of constant ionic strength covering the pH range 2 to 13. All the polarographic waves produced were diffusion controlled. The half-wave potentials, diffusion current constants and the reduction potentials were determined for the polarographic waves produced by these compounds. Logarithmic analyses of these waves indicated that the reduction processes were irreversible. The number of electrons involved per molecule of quinoline acid reduced was determined by coulometric analysis. Under appropriate conditions, the wave heights vary linearly with the concentration of quinoline acid.

The effect of ionic strength upon the polarographic properties of the four quinoline acids mentioned above was studied. General review of the polarographic properties of all seven of the isomeric quinoline monocarboxylic acids was made and mechanisms for their electroreduction discussed. The relative ease of reduction of the various acids was related to data such as the electron densities of the various positions in the quinoline ring.

Approximate solubilities of the four quinoline acids used in this study were determined in ethanol and water. A brief attempt was made to use solutions of the quinoline acids investigated as precipitants for amperometric titrations of metallic cations.

Microfilm $2.75; Xerox $8.20. 179 pages.

A POLAROGRAPHIC STUDY OF SOME COMPLEXES OF MOLYBDENUM

(L. C. Card No. Mic 61-2107)

Edward Wayne Zahnow, Ph.D.
University of Washington, 1961

Chairman: Rex J. Robinson

The catalytic current which results from the reduction of the perchlorate ion or the nitrate ion by molybdenum in one of its lower oxidation states can be decreased and even entirely eliminated by the presence of ions or molecules which complex with molybdenum.

Instability constants and the ratios of molybdenum to complexing agent have been evaluated for three complexes of Mo(IV) and for two complexes of Mo(III) by correlating the magnitude of the catalytic current observed with the degree of complex formation in the solution.

The catalytic reduction of oxalic acid or the oxalate ion by Mo(IV) has been observed. In 0.1 M HCl the catalytic current due to this reaction can be used to determine oxalic acid or oxalate ion quantitatively within a rather narrow range of concentration.

The complete suppression of the catalytic current can be accomplished by the addition of citric acid to perchloric acid and nitric acid solutions of molybdenum. Molybdenum may be determined quantitatively within one percent in the concentration range of 2×10^{-5} M to 2×10^{-3} M without the use of a calibration curve.

Microfilm $2.75; Xerox $3.80. 68 pages.

CHEMISTRY, BIOLOGICAL

QUANTITATIVE STUDIES ON INSULIN ACTION

(L. C. Card No. Mic 61-1593)

William King Baker, Ph.D.
University of Illinois, 1961

A large and reproducible effect of insulin on glucose uptake can be obtained with epididymal fat tissue. A significant effect is observed with less than 50 units in this system, and a maximum effect is observed with 1000 units.

An incubation procedure involving periodic replacement of the medium has provided a convenient means for studying the effects of the variation of a number of parameters and over periods of time up to 2 hours.

Simplified media composed of tris buffers and glucose have provided a means of investigating the effects of anions as well as cations in media of approximately normal ionic strength and tonicity. Tissue responded normally to insulin when tris H was the major cation in the medium. Trace amounts of metals were the only other cations. The uptake of zinc is not affected by insulin, and zinc is probably not required for insulin action. In testing anions it was observed that a normal insulin response was obtained in tris chloride, and rather small insulin effects were observed in tris sulfate and tris bromide. In tris acetate, the glucose uptake by tissue without insulin increased until it was nearly as rapid as glucose uptake by insulin stimulated tissue.

A maximum insulin effect was observed at pH 7 in tris chloride. As the pH was lowered from 7 to 6 the glucose uptake by tissue with insulin decreased, and that of tissue without insulin remained constant. As pH was increased from 7 to 8 high glucose uptake by insulin-treated tissues continued, and that of tissue without insulin increased until the insulin effect was lost.

The term actuation is suggested to describe the effect of high pH, ionic stimulation or mechanical damage in which the observation of an insulin stimulation is lost due to the high rate of glucose uptake by tissue without insulin. This process may be compared in some ways to uncoupling of oxidative phosphorylation.

Lineweaver-Burk plots of glucose uptake by tissue with or without insulin as a function of glucose concentration are consistent with a model of insulin action which involves a relief of competitive inhibition, or a specific activation of the binding of glucose to the rate limiting site.

An average insulin stimulation of glucose uptake of five to ten fold was observed at each of several glucose concentrations. In low glucose concentrations, an initially low rate of glucose uptake was observed to increase in succeeding periods, and in high glucose medium, this was reversed.

Insulin stimulation initiated aerobically continued anaerobically, but no insulin stimulation was observed in tissue that was made anaerobic before the addition of insulin.

The Q_{10} of glucose uptake by tissue was observed to be 2 to 3 in tissue without insulin, and 4 to 6 in tissue with insulin.

Estimation of the number of binding sites by measurement of the removal of tritiated insulin from the medium was less than 200 sites per cell.

A model was assumed in which insulin was bound to tissue in a way which activates glucose entry, and the fractional stimulation of glucose uptake by the tissue was assumed to be proportional to the fraction of insulin binding sites occupied. The number of insulin binding sites per cell estimated on the basis of this model was found to be 4800. The discrepancy of these two estimates is taken to mean that the assumption made in this analysis concerning the binding of insulin were incorrect.

Equilibrium dialysis measurements indicated a significant interaction between insulin and glucose. This could represent functional interaction, especially if insulin is sufficiently altered by an interaction with tissue to increase its capacity to bind glucose. G-1-P, G-6-P and F-1,6-P were not shown to interact with insulin.

The pertinence of these findings to the definition of insulin action is discussed.

Microfilm $2.75; Xerox $6.60. 137 pages.

AN ENZYMATIC STUDY OF THE CARBOXYLATION REACTION IN LEUCINE METABOLISM

(L. C. Card No. Mic 60-6847)

Alice del Campillo Campbell, Ph.D.
University of Michigan, 1960

The importance of leucine as a dietary essential for man and for animals and its function in protein synthesis have been established for many years. Recent work in several laboratories has indicated that in living cells this amino acid and acetate yield common intermediates which give rise to a variety of biologically important compounds such as rubber, the steroids, and the terpenes, as well as certain vitamins, essential oils, and alkaloids. For example, the intermediates from leucine degradation have been shown to be utilized effectively in cholesterol biosynthesis.

The over-all enzymatic conversion of leucine to acetoacetate and acetyl CoA was studied earlier in this laboratory. In this conversion two chemical reactions take place which are unique in fatty acid metabolism, the fixation of carbon dioxide into the carboxyl position of acetoacetate, and the cleavage of a branched carbon chain without prior formation of a β-keto acid. The cleavage reaction was studied in this laboratory with partially purified enzymes and shown to occur as follows:

β-Hydroxy-β-methylglutaryl CoA (HMG CoA) → acetoacetate + acetyl CoA. The carboxylation reaction leading to the formation of HMG CoA, was studied in relatively crude enzyme preparations. It was found that heart extracts apparently catalyze the formation of HMG CoA from β-hydroxyisovaleryl CoA, (HIV CoA), an intermediate in leucine metabolism, in the presence of ATP. It was the purpose of this investigation to study the enzymatic carboxylation reaction in detail and to establish the identity of the substrate and the sequence of reactions leading from β-methylcrotonyl CoA to acetoacetate.

For this purpose, an enzyme was purified about 100-fold from chicken liver which catalyzes the carboxylation reaction. No evidence was obtained that more than one enzyme participates in this reaction. Although this enzyme is rather unstable, with the purified enzyme it was possible to establish that β-methylcrotonyl CoA (MC CoA), another intermediate in leucine metabolism, is the actual substrate for the ATP-dependent carboxylation reaction, and that the product of the reaction is β-methylglutaconyl CoA. HIV CoA is not active in the system unless crotonase is present to convert it to MC CoA. HMG CoA is formed subsequently by the action of a specific hydrase, β-methylglutaconase; a requirement for this hydrase was shown. Acetoacetate is then formed from HMG CoA by the action of the cleavage enzyme as indicated above. The formation of acetoacetate from MC CoA may then be formulated as follows:

(1) MC CoA + ATP + CO_2 ⇄ β-methylglutaconyl CoA + ADP + phosphate

(2) β-methylglutaconyl CoA + H_2O ⇄ HMG CoA

(3) HMG CoA → acetoacetate + acetyl CoA.

Reaction 1 is catalyzed by the purified chicken liver carboxylase, and does not require the presence of additional

enzymes; Reaction 2 is catalyzed by methylglutaconase, and Reaction 3 by the cleavage enzyme. As predicted from this sequence, the carboxylation reaction, measured by acetoacetate formation, was found to be dependent on ATP, bicarbonate, methylglutaconase, cleavage enzyme, substrate, and carboxylase. A metal requirement (Mg^{++} or Mn^{++} ions) was established for Reaction 1.

The product of Reaction 1, β-methylglutaconyl CoA, was characterized by its absorption spectrum after isolation from the reaction mixture by paper chromatography or by chromatography of the corresponding hydroxamic acid. ADP and phosphate were identified as the breakdown products of ATP in Reaction 1. The data indicate that 1 mole of phosphate is liberated from ATP per mole of acetoacetate formed in the over-all conversion of MC CoA to acetoacetate. Since the heart carboxylase has not been purified, it is not possible to conclude whether the substrate carboxylated is different from that established for liver. On the other hand, work by others has recently shown that MC CoA is the substrate carboxylated by certain bacteria. Furthermore, the carboxylation of MC CoA rather than HIV CoA would be predicted on organic chemical grounds.

MC CoA carboxylase is present in extracts of liver, heart, kidney, yeast, and Neurospora crassa. The purified enzyme has a high affinity for MC CoA, ATP, and CO_2. The K_m value for MC CoA was found to be 3.1×10^{-4} M, and for ATP 2.9×10^{-4} M. P-Mercuribenzoate inhibits the enzyme, suggesting that one or more free sulfhydryl groups may be involved in the reaction.

In confirmation of earlier studies in this laboratory MC CoA carboxylase was found to be absent in extracts from biotin-deficient rat livers, while the cleavage enzyme is present. In attempts to establish the role of biotin the purified enzyme was found to contain bound biotin and to be inhibited by avidin. Biotin protects the enzyme against avidin inhibition and also partly reverses the inhibition by avidin. These results indicate that biotin participates in the carboxylation reaction in leucine metabolism. The exact role of biotin in this and other carboxylation reactions in animal tissues remains to be established.

Microfilm $2.75; Xerox $5.20. 105 pages.

SOME ANALOGUES OF α-KETO ACIDS AND OF PANTOTHENIC ACID

(L. C. Card No. Mic 61-1386)

John D. Fissekis, Ph.D.
The University of Texas, 1960

Supervisor: William Shive

During the course of these investigations, three α-keto acid analogues were prepared, i.e., cyclopentane- and cyclohexaneglyoxylic acids, and α-keto-3-cyclohexenepropionic acid. They were synthesized by condensing the corresponding cycloalkylcarbonyl derivative (cyclopentanone, cyclohexanone, and 3-cyclohexenecarboxaldehyde, respectively) with hippuric acid to form the 4-cycloalkylidene-2-phenyl-2-oxazoline-5-ones. Alkaline hydrolysis of the latter derivatives yielded the respective α-benzamido-β-cycloalkylidineacetic acids, which were subsequently hydrolyzed under acid conditions to give the mentioned α-keto acids. The free acids were usually converted to the potassium salts for storage due to their lability under acid conditions. The analogues gave the anticipated carbonyl condensation products with hydrazine derivatives.

Cyclopentaneglyoxylic acid inhibits in a competitive manner the utilization of α-keto-β-methylvaleric acid by Lactobacillus arabinosus 17-5; whereas, the corresponding cyclohexane analogue, cyclohexaneglyoxylic acid, is inactive in this assay system. The latter results are not unexpected since the corresponding amino acid analogue, cyclohexaneglycine, was also inactive as an antimetabolite. The specificity of the cyclopentyl group in replacing the sec-butyl group of natural metabolites with the resultant retention of enzyme binding ability of the corresponding analogue is thus demonstrated in α-keto acid analogues as well as amino acid analogues. Under appropriate conditions, cyclopentaneglyoxylic acid was shown to be more effective than cyclopentaneglycine in inhibiting the utilization of α-keto-β-methylvaleric acid.

α-Keto-3-cyclohexenepropionic acid was only slightly inhibitory in the assay systems studied, and its toxicity was insufficient to carry out a complete biochemical study. The corresponding 3-cyclohexenealanine which has been reported elsewhere was only slightly effective as a metabolite antagonist.

Hippuric acid was condensed with several alicyclic, aliphatic and aromatic aldehydes to yield the corresponding 4-(substituted)-2-phenyl-2-oxazoline-5-ones. Using acid hydrolysis, several of these compounds were converted to the corresponding α-keto acid derivative. Cyclohexane- and cyclopentane-glyoxylic acids were condensed with o-phenylenediamine to form the corresponding 2-(cycloalkyl)-3-hydroxyquinoxalines, and the latter two keto acids were also allowed to react with 4,5,6-triaminopyrimidine to form the corresponding cycloalkylhydroxy-4-aminopteridine derivatives. The 6-hydroxy isomers inhibited the growth of a number of organisms. Several natural extracts, folinic acid and related compounds did not reverse the growth inhibition caused by these pteridines.

Cyclopentane- and cyclohexaneglyoxylic acids were condensed with formaldehyde and the hydroxymethyl analogues formed were then converted to the corresponding α-ketolactones. Reduction of the α-keto grouping to an alcohol produced cycloalkyl- analogues of pantolactone. The lactone of the cyclopentane derivative, α-hydroxy-1-(hydroxymethyl)cyclopentaneacetic acid, was then condensed with β-alanine to form the pantothenic acid analogue. The latter compound, N-[α-hydroxy-1-(hydroxymethyl)cyclopentaneacetyl]-β-alanine, was isolated as a crystalline derivative through formation of its cinchonine salt. The cyclopentane analogue of pantothenic acid inhibited the growth of Streptococcus lactis 8039 and Lactobacillus arabinosus 17-5, and the inhibitions were competitively reversed by pantothenic acid. The inhibition indices for half-maximal growth of these two organisms were about 2500 and 3300, respectively.

A thermal condensation between pantolactone and various amines has resulted in the formation of 9 new N-pantoyl-(substituted)amines. The derivatives crystallized with difficulty; however, an acceptable elemental analysis could be obtained even on the analogues which were isolated as semi-solids. The condensation product with carboxymethoxylamine (aminoöxyacetic acid) proved

to be difficult to purify, and it was finally isolated as a cinchonine salt.

The inhibitory properties of the pantothenic acid analogues were examined in three organisms, Lactobacillus arabinosus 17-5, Streptococcus lactis 8039, and Leuconostoc mesenteroides P-60. For comparison purposes, the toxicity of the derivatives were related with N-pantoylbutylamine, a previously reported effective competitive antagonist of pantothenic acid. For L. mesenteroides and L. arabinosus, the most effective competitive antagonist prepared in this study was N-pantoyl-7-phenylheptylamine, which had inhibition indices for maximal inhibition of 2.5 and 400, respectively, in these two microörganisms. In S. lactis, the most inhibitory analogue studied was N-pantoyl-5-phenylpentylamine which had an inhibition index for maximal inhibition of 50. In every instance cited above the indicated analogue was more toxic than N-pantoylbutylamine, and they were competitively reversed by DL-(+)calcium pantothenate over a broad range of inhibitory concentrations.

Microfilm $2.75; Xerox $5.20. 102 pages.

COMPARATIVE BIOCHEMISTRY OF MUCOLIPIDS

(L. C. Card No. Mic 61-1402)

Owen Walter Garrigan, Ph.D.
Columbia University, 1961

"Mucolipid" is a group designation for the complex lipid polymers that combine constituents proper to cerebrosides with those usually found in mucoids. (Rosenberg, A., and Chargaff, E., J. Biol. Chem., 232, 1031, 1958.) Sialic acid (N-acetyl neuraminic acid) distinguishes mucolipids from other glycolipids and sphingolipids; thus, mucolipid-bound sialic acid is taken as a measure of the presence of this class of compounds.

Part I - Some Aspects of Mucolipid Ontogeny

The formation of mucolipids and other brain constituents was followed in the developing chick embryo. Mucolipids were isolated from the adult chicken brain and at ten stages of the chick embryo brain. The amount per cell, the composition and some physical properties of the mucolipids were compared. Cerebrosides were isolated and quantitatively determined at each stage. The mucolipid-bound sialic acid and the cerebrosides respectively (in picograms per cell) were: 4 1/2 to 5 days, 0.06, 2.04; 8 days, 0.20, 1.66; 10 days, 0.35, 2.59; 13 days, 0.67, 5.03; 15 days, 0.80, 4.98; 18 days, 1.39, 5.93; hatching, 1.52, 8.6; hatching + 2 days, 1.54, 12.1; adult, 2.02, 57.9.

The crude mucolipid at the early stages differed markedly in composition from that at hatching. At 9 days, sialic acid accounted for 7%, and amino acids for 40%, of the mucolipid fraction. The composition of mucolipid at hatching and in the adult were similar.

Even crude mucolipid fractions exhibited a single electrophoretic peak. The mucolipid fraction of the early stages differed from the adult in electrophoretic mobility, solubility and fractionation behavior. The relationship between mucolipid formation and cerebroside formation, the presence of "pre-myelin" cerebrosides and the abnormal composition of the mucolipid fraction of the early chick embryo brain were discussed.

A method of isolating DNA from defatted brain tissue was described. The base composition of the embryonic and adult chicken brain DNA was found to be similar to each other and similar to values for embryonic carcass, hen erythrocytes and hen egg white. The base ratios for the 9-day embryo brain and adult brain respectively were: thymine, 28.9, 29.6; adenine, 29.6, 29.2; cytosine, 21.9, 21.0; guanine, 19.6, 20.1; purines/pyrimidines, 0.97, 0.98; % yield, 102, 94; A+T/C+G, 1.41, 1.43.

Part II - Some Aspects of Mucolipid Phylogeny

A comparison was made of mucolipids from the brains of eleven species, including mammals, birds, amphibia and fish. The mucolipid-bound sialic acid was found to be relatively constant from species to species. Tissues other than brain lacked a comparable mucolipid content. The average amount (mg/g wet weight) of mucolipid-bound sialic acid in Stage I preparations from the brain tissue of various species was: ox, 0.65; sheep, 0.90; dog, 0.79; cat, 0.53; rabbit, 0.68; rat, 0.53; chicken, 0.55; alligator, 0.68; frog, 0.22; electric eel, 0.40; cod, 0.46.

Three species were selected for further chemical, physical and enzymic studies (ox, dog and chicken). The isolation of mucolipids from the tissues by the partition dialysis method was followed by purification procedures involving salt dissociation, redistribution, mild acid treatment, countercurrent distribution and chromatography on cellulose. The composition of purified mucolipids of the three species was similar. The molar ratios of the individual amino acids of the peptide portion of the mucolipids were also similar from species to species with several reproducible exceptions.

Ox brain mucolipid, purified by three different procedures, had the same content of amino acids (about 0.3 μmoles of amino acid per mg of mucolipid). Purified preparations of dog and chicken mucolipid were in the same range. Serine was identified as the only N-terminal amino acid in all three preparations. In ox brain mucolipid, one serine in four was N-terminal and the average peptide chain length was about 40 amino acid residues. Leucine aminopeptidase was found to attack the mucolipid stepwise from the N-terminal end of the peptide portion.

Microfilm $2.75; Xerox $5.80. 116 pages.

ISOLATION AND CHARACTERIZATION OF MUSCLE ENOLASE

(L. C. Card No. Mic 61-1624)

James Allen Holt, Ph.D.
University of Illinois, 1961

Proteins bearing the function for catalyzing the interconversion of D-glyceric acid 2-phosphate and enolpyruvic acid phosphate in the presence of certain divalent metal ions have been isolated and studied from both yeast and plant sources. This enzyme, enolase, has been less extensively studied from mammalian sources. This work presents the isolation and characterization of enolase from rabbit muscle.

Isolation of the enzyme involves preparation of an aqueous extract of rabbit skeletal muscle in 0.05% versene solution, fractionation of the protein solution in acetone, treatment at 55°C. in 5% $MgSO_4$ for 5 minutes, and fractionation with ammonium sulfate. Enolase may be obtained in crystalline form from the fraction precipitating in the range of 60-70% saturation with ammonium sulfate by preparing concentrated protein solutions in 60% ammonium sulfate saturated with magnesium sulfate, and adjusting the pH to 7.8 with ammonium hydroxide. The specific activity of the crystals remains constant after a single recrystallization and one milligram of this material catalyzes the conversion of 0.226 micromoles of substrate to product in one minute at 25°C.

The physical properties of the enzyme have been studied in imidazole-$MgCl_2$ buffer, ionic strength 0.1, pH 7.07, at 1°C. Under these conditions $s_0 = 3.461 \times 10^{-13}$ sec., $D_0 = 3.416 \times 10^{-7}$ $cm^2/sec.$, and $\overline{V} = 0.728$ $cm^3/gm.$ The sedimentation and diffusion data indicate a molecular weight of 85,000 for muscle enolase. Measurements by the Archibald approach to sedimentation equilibrium method give molecular weight values in the range of 77,000.

The amino acid content of muscle enolase has been determined and found to differ from the protein bearing a similar catalytic function isolated from either yeast or potato. The muscle enzyme contains appreciably less serine than the yeast enzyme and also contains 3 to 4 cysteine (or $\frac{1}{2}$ cystine) residues per mole, whereas the yeast enzyme has no cysteine or cystine. In general amino acid content, the enzymes isolated from yeast and muscle show greater similarity than does the potato enzyme.

The kinetics of the muscle enolase catalyzed reaction indicate K_M values for the substrate and magnesium in imidazole buffer of approximately 10^{-4} M and 3×10^{-4} M, respectively. These values are similar to those determined under identical conditions for the enzyme isolated from yeast, but the pH optimum of the muscle enzyme, 6.7, is about one unit lower than the optimum for the enzyme from yeast. The muscle enzyme exhibits the greatest specificity in its metal ion requirement. Zn^{++}, Co^{++}, Ni^{++}, and Mn^{++} show less than 1/3 the activity exhibited with magnesium. Inhibition experiments indicate that maintenance of the sulfhydryl groups in the reduced form is not essential for the activity of the muscle enzyme, as has been demonstrated for the enzyme from potato.

Isotope methods have been used to investigate the mechanism of the muscle enolase catalyzed reaction. The ratio of the initial reaction rate in H_2O to that in D_2O is 1.67 for the forward reaction and 1.89 for the reverse reaction. The substrate analogue, D,L-dihydroxyisobutyric acid 2-phosphate, has been used to investigate the possible exchange of the β-hydroxyl group occurring independently of the over-all reaction. No enzyme catalyzed exchange of this group with O^{18} from the medium was observed. Proposed studies to examine further the mechanism of the enolase catalyzed reaction include comparison of reaction rates with the α-deuterated substrate and the normal substrate and an investigation of the possibility of an enzyme catalyzed exchange of the α-hydrogen in lactic acid 2-phosphate.

Microfilm $2.75; Xerox $4.80. 92 pages.

CARBOHYDRATE METABOLISM AND ELECTRON TRANSPORT SYSTEMS IN THE ERGOT FUNGUS, CLAVICEPS PURPUREA.

(L. C. Card No. Mic 61-962)

John Kennely McDonald, Ph.D.
Oregon State College, 1961

Major Professors: Tsoo E. King
Vernon H. Cheldelin

Cell-free preparations were obtained by sonic disintegration followed by low-speed centrifugation. The enzymes of the Embden-Meyerhof-Krebs cycle route of glucose catabolism were demonstrated by the extent to which several intermediates of this pathway were oxidized, as measured by the reduction of triphenyltetrazolium chloride. It was necessary to use such an artificial electron acceptor since molecular oxygen would not serve as the acceptor in cell-free extracts. Many individual enzyme-catalyzed reactions of the glycolysis-Krebs cycle route, and the pentose phosphate pathway were studied chemically, chromatographically, and spectrophotometrically.

The time-course oxidation of various specifically C^{14}-labeled forms of glucose, gluconolactone, and ribose was followed by the technique of radiorespirometry. Growing cells of C. purpurea were calculated to employ the glycolysis-Krebs cycle route for about 90 per cent of its glucose catabolism, with the remaining 10 per cent apparently being dissimilated by the pentose cycle. A similar study with resting cells revealed an increased preference for the former pathway, resulting in a decrease of 50 to 60 per cent in the utilization of the latter route.

The study of electron transport by cell extracts of the fungus revealed a unique succinic dehydrogenase. The dehydrogenase was readily solubilized by various methods of cell disruption. The enzyme, both in cell-extracts and in purified preparations, was found to react with phenazine methosulfate only. Other electron acceptors such as triphenyltetrazolium chloride, methylene blue, 2,6-dichlorophenolindophenol, ferricyanide, and mammalian cytochrome c all appeared to be ineffective. Phenazine methosulfate was used routinely for the manometric assay of the enzyme, and the optimum concentrations of cyanide, succinate, and dye were determined to be 0.005, 0.1, and 0.005 M, respectively.

For purification purposes, large amounts of the fungal tissue were extracted by blending the cells for 2 minutes with alumina. This treatment did not solubilize cytochrome c, whereas ultrasonic disintegration did. The soluble succinic dehydrogenase in the cell extract was purified by ultracentrifugation, treatment with protamine sulfate to remove nucleic acids, followed by ammonium sulfate fractionation and dialysis. The purification was approximately 51 fold, on a dry weight basis, over the original cell slurry. The purified enzyme proved to be exceptionally stable, showing approximately 10 per cent inactivation after 1 month at -15 C, and 29 per cent inactivation after 13 hours at 20 C. The enzyme also showed little, if any need for protection against the H_2O_2 formed in the assay system, as was indicated by a lack of any significant difference in the cyanide-treated and -untreated assay systems.

The oxidation of succinate to fumarate, catalyzed by the Claviceps dehydrogenase, proved to have an energy of activation of about 9,380 calories at a pH optimum of 7.7. The Michaelis constant, K_m, was determined to be 3×10^{-3} M at pH 7.7 and 35 C.

Fumarate, pyrophosphate, and malonate proved to be competitive inhibitors of the dehydrogenation, and their respective dissociation constants, K_i, for the enzyme-inhibitor complexes, were calculated to be 9.3×10^{-4} M, 4.2×10^{-4} M, and 3.0×10^{-5} M. The non-competitive inhibition shown by the iron-chelating agent o-phenanthroline indicated iron to be a component of the Claviceps enzyme, but this inhibition does not prove the essentiality or redox participation of the iron. The dissociation constant for the enzyme-o-phenanthrolate complex was found to be 3.0×10^{-4} M.

The presence of flavin in the purified preparation was suggested by the absorption spectrum for the oxidized enzyme, and by the difference spectrum for the oxidized and reduced forms of the dehydrogenase. The absorption spectrum also indicated the apparent absence of any cytochrome components.

Microfilm $2.75; Xerox $8.20. 179 pages.

CHANGES IN THE BLOOD LEVELS OF NONPROTEIN NITROGEN AND ARGININE DURING THE UPSTREAM MIGRATION OF COLUMBIA RIVER BLUEBACK SALMON (ONCORHYNCHUS NERKA)

(L. C. Card No. Mic 61-1327)

Roy Eiji Nakatani, Ph.D.
University of Washington, 1960

Chairman: Allan C. DeLacy

The blood levels of N.P.N. (nonprotein nitrogen) and "arginine" in the Columbia River blueback salmon were investigated for the runs of 1956 and 1957 in order to characterize by blood chemistry the adult migrants at different dam sites located along the upstream migration route of over 500 miles. Fish were sampled at five widely separated sites, Bonneville, McNary, Rock Island, and Tumwater Dams and on the spawning grounds. Because of the interest in finding a feature of the blood which might serve as an indicator of the stage of sexual maturity of adult migrants, the mutual relationship between blood "arginine" and weight of gonads was also studied. The effect of artificially induced "delay" at dam sites on the two blood constituents was studied in 1957 by comparison of migrating bluebacks with captive fish held in live boxes at Bonneville, McNary, and Rock Island Dams.

A marked decrease in blood N.P.N. levels occurred with upstream migration. From a statistical viewpoint three distinct groups with the following mean values were observed: 80 mg per cent at Bonneville; 67 and 66 mg per cent at McNary and Rock Island respectively; and 60 and 62 mg per cent at Tumwater and spawning grounds respectively. No statistical difference was found between sexes, years, or different segments of the 1957 run.

Blood "arginine" was defined to include not only free arginine, but also an unknown Sakaguchi positive arginine-like compound found in trichloroacetic acid blood extracts. The presence of these two Sakaguchi positive substances was demonstrated by separation of free amino acids by high voltage paper electrophoresis and subsequent development of a chromatogram by Sakaguchi reagents. The results of blood "arginine" were thus given by spectrophotometric data rather than concentrations expressed as free arginine.

In both years an increase of approximately 25 to 30 per cent in blood "arginine" was detected during the river migration between Bonneville and Tumwater Dams, a distance of about 360 miles; however, at a later period of the migration, blood "arginine" must have decreased sharply for the lowest levels were observed on the spawning grounds. Blood "arginine" is proposed as a blood index of much promise to stage the sexual maturity of the bluebacks during the actual river migration. Highly significant correlation was found in both years between gonad weight and blood "arginine" for the females sampled at dam sites. Significant relationships were also found for the males in 1956, but not in 1957. The run of 1957 showed a consistently higher mean blood "arginine" at all dam sites than the run of 1956, which led to the suggestion that the run of 1957 on the average entered the river in a more advanced stage of maturity than the run of 1956.

Comparisons between the passing bluebacks and captive fish showed no difference in blood N.P.N., but blood "arginine" showed a decreasing trend when fish were held in live boxes. In view of the increase in blood "arginine" with upstream migration, the decreasing trend of the held fish suggested that "delays" may disrupt the maturation processes. On the premise that severe muscular activity is one of the primary effects of handling some experimental data on the effect of swimming exercise on blood N.P.N. and "arginine" were also presented and discussed.

Microfilm $2.75; Xerox $7.40. 159 pages.

STEROL PHYSIOLOGY OF PLEUROPNEUMONIA-LIKE ORGANISMS

(L. C. Card No. Mic 61-2064)

George Harris Rothblat, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Paul F. Smith

The purpose of this investigation was to study the uptake of sterol by pleuropneumonia-like organisms (PPLO) and to determine its fate by characterization of the nature and location of the non-saponifiable lipids in these organisms.

Uptake of sterol was studied primarily in the "parasitic" non-fermentative human PPLO, strain 07. The pattern of non-saponifiable lipids and the location of steroids within PPLO was determined in the human 07 strain, the fermentative avian strain J, and the "saprophytic" Laidlaw B strain of PPLO.

Cholesterol-4-C^{14} was removed from the supernatant medium by resting and growing cells of PPLO. This sterol was found to be incorporated solely in the non-saponifiable lipid fraction, the major portion of which was located in the cell membrane. This distribution of

non-saponifiable lipid was further verified by the lytic activity of digitonin on the cells containing sterol. The sterol was taken up by an irreversible adsorption process and can be removed only by solvent extraction. The initial adsorption process is affected by time, temperature, cell concentration, and pH, but not by respiratory poisons and destruction of protein end group on the cell surface. Only steroids possessing a side chain similar to cholesterol are adsorbed, indicating that adsorption of the steroid occurs through the 8 carbon side chain.

Starting with chromatographically pure crystalline C^{14} cholesterol in the growth medium, the non-saponifiable lipid fractions of strains 07, J, and Laidlaw B were isolated and chromatographed on silicic acid columns. The non-saponifiable lipid fraction of strain 07, which requires cholesterol but fails to metabolize glucose, was shown to have only one component. This compound was crystallized and identified as cholesterol by physical, chemical, and chromatographic procedures. The non-saponifiable lipid fraction of strain J, which requires cholesterol and metabolizes glucose, was found to have two components, one being cholesterol. The second compound had the same physical-chemical characteristics as cholesteryl glucoside. It was more polar than cholesterol, gave a positive Liebermann-Burchard reaction, was non-precipitable with digitonin and melted at 283°C. The non-saponifiable lipid fraction of strain Laidlaw B grown in the absence of cholesterol contained four fractions, all pigmented yellow.

The major fraction was identified as the carotenoid, neurosporene. When strain Laidlaw B was grown in the presence of cholesterol, cholesterol and cholesteryl glucoside were found in addition to all the pigments.

The possible function of cholesterol and cholestery glucoside in PPLO is discussed.

Microfilm $2.75; Xerox $4.00. 72 pages.

THE ROLE OF NUCLEOTIDES IN THE BIOSYNTHESIS OF L-RHAMNOSE

(L. C. Card No. Mic 61-1976)

Eldon William Shuey, Ph.D.
The University of Nebraska, 1961

Adviser: John H. Pazur

Deoxyhexoses are present in biological materials as constituents of the heteropolysaccharides found in the cell walls of bacteria and plants, as the carbohydrate moiety of many plant glycosides and as constituents of certain lipopolysaccharides and endotoxins produced by microorganisms. One of the more abundantly occurring deoxyhexoses is L-rhamnose (6-deoxy-L-mannose). It has been shown to occur in various plant and bacterial materials and to be a major constituent of the cell wall of Streptococcus faecalis.

Because of the unusual L configuration and the presence of the 6 deoxy group in these compounds, the biochemistry of deoxyhexoses has received considerable attention in recent years. Early work in the area of deoxyhexose biosynthesis was concerned with elaborating pathways whereby these compounds were formed by condensation of appropriate three carbon units. However, isotope studies indicate that deoxyhexoses are not formed by condensation of three carbon fragments but rather show that these compounds are formed from hexoses by steps which do not involve a cleavage of the carbon chain. Carbohydrate transformations of this type have been shown to occur via uridine or guanosine nucleotides.

When S. faecalis was grown on glucose-1-C^{14}, it was found that the rhamnose isolated from its cell wall was labeled predominantly in carbon 1, indicating a direct conversion of glucose units to rhamnose. This conversion has been found to occur via a new series of carbohydrate nucleotides, namely thymidine compounds. Cell free extracts of S. faecalis were shown to contain a thymidine diphosphate glucose pyrophosphorylase which catalyzes the formation of thymidine diphosphate glucose (TDPG) from thymidine triphosphate (TTP) and glucose-1-phosphate (G-1-P). This thymidine diphosphate glucose pyrophosphorylase activity was shown to be present in all bacterial and plant materials examined which contain rhamnose but was absent in materials which do not contain rhamnose. Extracts of several organisms were also shown to contain a multi-enzyme complex which has been termed "epimerase-dehydrogenase" which catalyzes the conversion of thymidine diphosphate glucose to thymidine diphosphate rhamnose (TDPRh).

Thymidine diphosphate glucose has been prepared in pure form and characterized by identification of its acid hydrolytic products. Pure thymidine diphosphate glucose was converted to thymidine diphosphate rhamnose by S. faecalis extracts. This conversion required reduced triphosphopyridine (TPNH).

Based on this information and other established biochemical reactions, the following sequence is proposed for the biosynthesis of L-rhamnose in biological systems:

(1) Glucose + ATP $\rightleftarrows$ G-6-P

(2) G-6-P $\rightleftarrows$ G-1-P

(3) TTP + G-1-P $\rightleftarrows$ TDPG + PP

(4) TDPG + TPNH + H^+ $\rightleftarrows$ TDPRh + TPN^+

The first reaction is the phosphorylation of glucose by adenosine triphosphate (ATP) in the presence of hexokinase to form glucose-6-phosphate (G-6-P) while the second reaction is the phosphoglucomutase reaction. Reaction 3 represents the synthesis of thymidine diphosphate glucose and pyrophosphate (PP) from thymidine triphosphate and glucose-1-phosphate catalyzed by thymidine diphosphate glucose pyrophosphorylase. Reaction 4 represents the conversion of TDPG to TDPRh by the epimerase-dehydrogenase complex and is probably a multi-step reaction as the conversion of the glucosyl moiety of TDPG to the rhamnosyl moiety of TDPRh requires three epimerizations and a reduction.

It is probable that thymidine nucleotides are important not only as intermediates in the biosynthesis of L-rhamnose but that TDPRh also serves as a carrier of rhamnosyl units for the synthesis of heteropolysaccharides, lipopolysaccharides and glycosides containing rhamnose.

Microfilm $2.75; Xerox $4.60. 88 pages.

STUDIES ON AMINO ACID REQUIREMENTS OF ADULT WHITE RATS

(L. C. Card No. Mic 61-1666)

Elizabeth Bernice Smith, Ph.D.
University of Illinois, 1961

An inadequate dietary intake of protein of good quality is the most widespread serious nutritional problem in technically underdeveloped areas. The specialized agencies of the United Nations concerned with nutrition are now exerting organized international effort on an unprecedented scale with the objective of closing the gap between the recommendations of the FAO Committee on Protein Requirements, and the prevailing situation where millions suffer from protein malnutrition.

For development of new protein sources, or new cereal or vegetable mixtures, availability of a reliable standard for evaluating the experimental products is an absolute prerequisite. Recent work tends to confirm the hypothesis that the protein which most closely approximates the organism's requirements for the essential amino acids is the one which it can utilize most efficiently.

When protein foods which bear an amino acid pattern similar to the growth requirement pattern are fed to adults of the species considerable wastage is involved. Thus it is postulated that the adoption of a reference protein based on maintenance requirement levels of the amino acids can effect real economies of protein supplies, and improved efficiency of protein nutrition for the adults of all species.

It was the objective of the studies described to determine the amino acid requirements of adult rats as a first step toward the development of a human amino acid requirement pattern. Slight modifications of the data, involving an estimation of the amino acids required to maintain the heavy hair coat would render the pattern suitable for human application, it is considered.

Experimental work was carried out in three phases. During Phase #1 adult male Wistar rats were fed complete diets at the 3.2% protein level to compare four amino acid patterns, viz., that of whole egg; of growing rat requirements; and two adult rat requirement patterns from the literature.

Since no clearly discernible differences appeared in the rats' responses to these four patterns, a basal pattern was designed for Phase #2 with each amino acid appearing at the lowest level at which it was administered during Phase #1. Modest increases of 50 to 100 percent were tested on groups of four rats each, by administering triads of the increased amino acids according to a factorial design. Those amino acids which appeared to be most responsible for favorable nitrogen balances when fed at the higher levels were retested in pairs.

The amino acid requirement pattern which was set up as a result of these studies was incorporated in the control diet for Phase #3 and intensive studies carried out to discover if surpluses were present. Graded reductions of all of the amino acids (except methionine and cystine which were not studied) were tested singly, using three rats per group and in a 3.6% protein diet.

The pattern emerging from these studies is considered to represent the minimum essential amino acid requirements for maintenance of well-nourished adult male rats.

Positive nitrogen balances do not necessarily reflect a possible nitrogen deficit in the blood, so it was considered desirable to measure blood protein status. Electrophoretic partition of the rats' serum was carried out, and the patterns compared with those of healthy animals from the colony. Since no significant differences were found, this is regarded as supporting evidence that the blood protein status of these animals (maintained on the newly derived amino acid pattern) was in no way different from the normal. Microfilm $2.75; Xerox $8.20. 177 pages.

GAS-LIQUID CHROMATOGRAPHIC IDENTIFICATION OF VOLATILE SUBSTANCES OF BIOCHEMICAL INTEREST

(L. C. Card No. Mic 61-1556)

William Alexander Brown Thomson, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor F. M. Strong

Part I. Volatile fatty acids of Ascaris lumbricoides.

The investigations in this study have been concerned with the separation and identification by gas-liquid chromatography of the methyl esters of volatile fatty acids excreted from axenic Ascaris lumbricoides.

Ten methyl ester peaks, of which three were major components and seven minor components, were detected. All but one were tentatively identified by comparison with the relative retention times of comparable standards under the same conditions.

The three major components were positively identified by infrared spectroscopy and preparation of amide derivatives as α-methyl n-butyric, n-valeric, and iso-caproic acids. The minor components were acetic, propionic, iso-butyric and/or trimethylacetic, n-butyric, trans-α-methyl crotonic (tiglic), and n-caproic acids, plus an unknown branched C_7 or C_8 acid.

The total mole percentages of the methyl esters of different carbon numbers were: C_2, 0.27%; C_3, 0.77%; C_4, 1.14%; C_5, 38.0%; C_6, 56.2% and C_{7-8}, 3.56%. The most abundant individual acids found were iso-caproic, 55.1 mole %, and α-methyl-n-butyric, 31.8 mole %.

Part II. Volatile flavoring substances from Cheddar cheese.

A four-fold concentration of the volatile flavoring substances in Cheddar cheese was achieved by physically removing the fat from the cheese. There was no marked difference between the gas-liquid chromatograms of the vapors over the whole cheese and over the cheese fat.

The typical Cheddar cheese aroma was removed from the fat by heating it to 85°C and passing nitrogen over the surface of the fat. A large fat surface was created by spinning the fat in a flask of special design. The effluent vapors were then chilled in traps held at -15°C and -190°C. The final trap in the series, which was immersed in liquid air, was of special design and small volume and its trapping efficiency was compared with that of traps of four other designs, at various gas flow rates.

The contents of the final trap were gas chromatographed

on Carbowax 1500 and the individual fractions were collected for analysis. The largest fraction was shown to be acetone by infrared spectroscopy and by mass spectrometry. The mass spectra of five other fractions were obtained and these showed the presence in cheese odor of acetaldehyde, 2-butanone, ethanol, and 2-butanol. One mass spectrum was not fully interpreted although it did not correspond to the mass spectrum of any compound previously attributed to the flavor of Cheddar cheese. Of those compounds identified 2-butanol had not hitherto been found in Cheddar cheese.

Samples of cheese were canned and by means of septa built into the cans the head-space vapors were removed for gas chromatographic analysis using a β-ray argon ionization detection system. Carbowax 1500 and tritolyl phosphate columns were employed. The retention volumes of the compounds in cheese volatiles were compared with similar data from numerous standard compounds chromatographed under the same conditions. In this way further proof of the identity of the compounds isolated was obtained.

The free fatty acids in the odor of cheese were not identified. A gas chromatographic technique was described to separate the acidic from the non-acidic volatile compounds in cheese odor, by the use of tritolyl phosphate as the liquid phase. Two temperatures were employed.

Part III. Volatile flavoring substances from dried whole milk.

The techniques described in Part II were utilized in order to determine the nature of the 'stale' odor that develops upon room temperature storage of dried whole milk. Acetone was identified as the most abundant compound in the odors of the fresh and the aged products. No other compounds were identified although gas chromatography revealed a substantial change in the composition of the odors with time of storage of the dried milk.

Microfilm $2.75; Xerox $8.20. 180 pages.

THERMAL COPOLYMERS OF AMINO ACIDS

(L. C. Card No. Mic 61-1296)

Allen Vegotsky, Ph.D.
The Florida State University, 1961

Numerous attempts to copolymerize thermally a dry mixture of eighteen amino acids in proportions based on the estimated average amino acid composition of protein resulted in negligible recoveries of dark reaction product. Marked increases in the weight yields of a polymeric reaction product resulted from increasing the proportion of aspartic acid in the reaction mixture (i.e. yields were increased from $0.9 \pm 1.0\%$ for controls without excess aspartic acid to $10.3 \pm 2.1\%$ for a ninefold excess of this amino acid). Yields were not increased by use of excess glutamic acid in place of aspartic acid. Addition of excess glutamic acid to reaction mixtures already rich in aspartic acid resulted in a depression of yields. The results with reaction mixtures of eighteen amino acids paralleled earlier findings in studies of the thermal copolymerization of proline with dicarboxylic amino acids. In the latter case, aspartic acid and proline copolymerized readily while glutamic acid failed to copolymerize with proline in workable yields.

When phosphoric acid or polyphosphoric acid was added to reaction mixtures of eighteen amino acids rich in aspartic acid, yields were increased twofold to threefold. Addition of small proportions of each of several other phosphate compounds such as adenosine triphosphate, adenosine monophosphate, calcium phosphate, and disodium hydrogen phosphate also resulted in higher yields of thermal copolymers of amino acids.

The mean molecular weight of one thermal preparation was found to be 3100 by a modified "Archibald" or "approach-to-equilibrium" ultracentrifugal method. The Archibald analysis showed that the thermal polymer was polydisperse with a distribution of molecular weight from 2800 to 3500.

Quantitative amino acid analyses revealed that several thermal polymers are composed mainly of aspartic acid as was inferred also from studies of infrared spectra. Sizable proportions of the other amino acids common to protein are also incorporated except serine and threonine which are only incorporated in trace proportions.

The finding of nonintegral numbers of amino acid residues in one preparation suggests that this substance is not homogeneous with respect to amino acid composition. This contention is supported by the finding of differences in the proportions of amino acids in the hydrolysates of two solvent fractions of the same polymer.

Paper electrophoretic studies in the pH range of 2.3 to 8.0 indicated that this polymer was composed predominantly of a strongly acidic substance which migrated toward the anode more rapidly than bovine plasma albumin and more slowly than thermal polyaspartic acid. The finding that a thermal polymer migrated as a single band at different pH values indicates a high degree of homogeneity as judged by paper electrophoresis. However, the fact that paper electrophoretic studies showed the same rate of migration for a polymer with 59.9% aspartic acid and for one containing 79.9% aspartic acid indicates that this approach is not a sensitive gauge of homogeneity for polymers rich in aspartic acid.

The proportions of amino acids in reaction mixtures and in hydrolysates of final products are different. This finding suggests that the thermal polycondensation is not a purely random process.

Attempts to induce antibodies to a thermal polymer of amino acids were unsuccessful.

Microfilm $2.75; Xerox $5.80. 117 pages.

CHEMISTRY, INORGANIC

THE REACTION OF PHOSPHORUS TRIFLUORIDE WITH ALUMINUM CHLORIDE AND RELATED STUDIES

(L. C. Card No. Mic 61-1713)

Earl Robert Alton, Jr., Ph.D.
University of Michigan, 1961

This investigation had as its chief purpose the study of certain reactions of aluminum chloride and aluminum trimethyl in order to obtain evidence pertaining to the role of π bonding in these reactions and to determine if any correlations could be made with the corresponding diborane systems.

The following systems were studied in the absence of a solvent using sealed tube techniques: aluminum chloride-phosphorus trifluoride, aluminum chloride-phosphorus trichloride, aluminum chloride-carbon monoxide, aluminum trimethyl-phosphorus trifluoride, aluminum trimethyl-carbon monoxide, and boron trifluoride-phosphorus trifluoride. In addition, the reaction of ammonia with aluminum trimethyl was studied using conventional vacuum line techniques. Evidence for reaction was based on the composition of the initial and final materials.

The following points were established for these systems. Phosphorus trifluoride and aluminum chloride react under a pressure of about eight atmospheres of phosphorus trifluoride to give the monomeric compound F_3PAlCl_3. This compound was characterized by stoichiometry, analysis of decomposition products, displacement of phosphorus trifluoride by trimethylamine, and the molecular weight of the compound. The molecular weight was determined by vapor pressure depression using liquid phosphorus trifluoride as a solvent. The compound F_3PAlCl_3 decomposes above -20°C. to give aluminum chloride and phosphorus trichloride.

Phosphorus trifluoride reacts with aluminum trimethyl to give products which are still unidentified. It is reasonable to expect that the first step in this system is the formation of an adduct $F_3PAl(CH_3)_3$ but there is no proof for such a compound as yet. Although carbon monoxide and phosphorus trifluoride complexes are known with both platinous chloride and the borane system, all attempts to bring about reaction between carbon monoxide and aluminum chloride as well as aluminum trimethyl were unsuccessful. Ammonia reacts with aluminum trimethyl to give the monomeric addition compound $NH_3Al(CH_3)_3$. Aluminum chloride is slightly soluble in liquid phosphorus trichloride at elevated temperatures but no other evidence for complex formation was found. Finally, there was no evidence for reaction between phosphorus trifluoride and boron trifluoride.

Unlike the diborane reaction with ammonia in which diborane is cleaved in an unsymmetrical fashion, no evidence was found in this study for a similar unsymmetrical cleavage of the aluminum dimers, aluminum chloride and aluminum trimethyl. On the other hand, aluminum chloride does react with phosphorus trifluoride as does diborane. This is especially significant, since the bonding of phosphorus trifluoride to platinous chloride was assumed to involve double bonds (π bonds) formed by donation of electrons in the 5 d orbital of platinum to vacant d orbitals in phosphorus. Such double bonds presumably could not be formed with boron or aluminum since no d electrons are available here.

A rationale for the reaction of phosphorus trifluoride with diborane and with aluminum chloride and its non-reactivity with boron trifluoride was formulated using the usual arguments of coordination chemistry and estimating the energies involved in changing the B-F distance in planar boron trifluoride to the B-F distance in a tetrahedral configuration as compared to the energy involved in a similar change for BH_3.

Microfilm $2.75; Xerox $4.60. 87 pages.

THE AMMONIA AND ALKYL AMINE ADDITION COMPOUNDS OF CARBON MONOXIDE-BORANE

(L. C. Card No. Mic 61-1730)

James Clyde Carter, Ph.D.
University of Michigan, 1961

The initial research on carbon monoxide-borane was done by Burg and Schlesinger [J. Am. Chem. Soc., 59, 780 (1937)]. They found that direct reaction of H_3BCO with trimethylamine results in a base displacement yielding trimethylamine-borane and carbon monoxide. In contrast, carbon monoxide-borane reacts with excess ammonia in the absence of other solvent to yield $H_3BCO(NH_3)_2$ in an addition reaction without liberation of carbon monoxide. The material $H_3BCO(NH_3)_2$ is a solid at room temperature and reacts with sodium in liquid ammonia producing one equivalent of hydrogen immediately and a second equivalent of hydrogen over a period of several hours. On the basis of this information, Burg and Schlesinger suggested that the product obtained from the reaction of carbon monoxide-borane and ammonia was either a diammonium salt or a mixture of ammonium salts.

The purpose of the present research was to determine the course of reaction of carbon monoxide-borane with methylamine and dimethylamine and to determine the structures of the products obtained from the interaction of carbon monoxide-borane with ammonia and the methyl amines.

Carbon monoxide-borane was found to react with ammonia, methylamine, and dimethylamine using methyl ether or ethyl ether as a solvent to yield compounds of the composition $H_3BCO(amine)_2$. The materials obtained were crystalline, and X-ray powder pattern data and infrared spectral data are given for these compounds. The reaction of carbon monoxide-borane and trimethylamine in methyl ether yielded an unstable adduct at low temperatures which decomposed on warming to room temperature to give trimethylamine-borane, carbon monoxide, and unidentified products.

The compound $H_3BCO{\cdot}2CH_3NH_2$ was found to be stable in air and water for periods of several hours. It reacted with an excess of sodium tetraphenylboron in aqueous solution to precipitate immediately one equivalent of methylammonium tetraphenylboron per formula weight of $H_3BCO{\cdot}2CH_3NH_2$. A compound of the composition NaH_3BCOCH_3NH was isolated from the reaction of one equivalent of sodium tetraphenylboron with one formula weight of $H_3BCO{\cdot}2CH_3NH_2$.

Sodium in liquid ammonia reacts with $H_3BCO \cdot 2CH_3NH_2$ to yield one equivalent of hydrogen per formula weight and a sodium salt identical to the one obtained from $H_3BCO \cdot 2CH_3NH_2$ and sodium tetraphenylboron in water. X-ray powder pattern data and infrared spectral data are given for this compound.

Molecular weights and conductance measurements on aqueous solutions of $H_3BCO \cdot 2CH_3NH_2$ and molecular weight measurements on the sodium salt showed that the materials are 1:1 electrolytes. Conductance measurements were also made on methylammonium N-methylcarbamate.

The structures of the ammonia, methylamine, and dimethylamine adducts of carbon monoxide-borane supported by the results of this study may be represented as

$$[H_2NRR'^{+}][\ \underset{\displaystyle NRR'}{\overset{\displaystyle H_3B}{\overset{|}{\underset{|}{C}}}}=O^{-}]$$

where R and R' may be either H or CH_3. The structure of the sodium salt obtained from $[CH_3NH_3^+][H_3BCONHCH_3^-]$ would then be $[Na^+][H_3BCONHCH_3^-]$. The compounds were named as boranocarbamates, for example $[CH_3NH_3^+][H_3BCONHCH_3^-]$ would be methylammonium N-methylboranocarbamate. Support is given for the similarity of compounds in which an oxygen is replaced by the isoelectronic BH_3 group.

The preparation of sodium N-methylamide is described.

Microfilm $2.75; Xerox $4.80. 92 pages.

THE COMPLEX STABILITIES OF THE LANTHANIDES WITH A SERIES OF α-HYDROXY CARBOXYLATE LIGANDS

(L. C. Card No. Mic 61-1279)

John Andrew Chopoorian, Ph.D.
The Florida State University, 1961

The stepwise formation constants (K_n, where $K_n = [ML_n] \cdot [ML_{n-1}]^{-1} \cdot [L]^{-1}$) have been determined for the α-hydroxy isobutyrate, lactate, and glycolate complexes of nine lanthanide elements and yttrium. The emf measurements used show the formation of anionic complexes of structure ML_4, but due to the large errors in K_4, only the first three formation constants were reported. A high speed digital computer method was developed for the calculation of these constants from the experimental data.

The order of stability observed, α-hydroxy isobutyrate > lactate > glycolate, was seen to be governed by an inductive effect of the ligand.

Except for irregularities in the Sm-Eu-Gd region, the trends of the formation constants of these metal-ligand systems, as a function of lanthanide ion atomic number, showed a smooth increase. These trends were also seen to reflect the previously observed behavior of α-hydroxy isobutyrate, lactate, and glycolate, as cation exchange elutrients for the lanthanides.

The complexes of Ce and Gd were studied at several temperatures, and ΔH and ΔS for the first formation steps of these systems were evaluated. However, the confidence limits of ΔH did not allow any definitive correlations to be made.

The results of this research are compared with previous complex studies using a wide range of lanthanide elements, and some consideration is given to coordination number as well as the trend irregularities in the Sm-Eu-Gd region.

The glycolate systems of the lanthanides were previously studied by A. Sonesson. In view of the slightly different temperatures used and the error limits concerned, there is good agreement between the two investigations. Microfilm $2.75; Xerox $6.60. 139 pages.

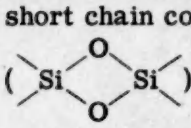
SOME ORGANO-SILICON AND -ALUMINUM POLYMERS

(L. C. Card No. Mic 61-1613)

Cliff Yasuo Fujikawa, Ph.D.
University of Illinois, 1961

The condensation reaction of silicon tetrachloride with a few polyfunctional organic compounds has been investigated.

Pentaerythritol, in its reactions with silicon tetrachloride, has given polymeric materials, some of which are soluble in the solvents used as reaction media and are probably short chain compounds. Others have the spiro-

siloxane  structure. These were found to

be quite insoluble in the usual solvents. The thermal stability determinations of these polymers were conducted in a simple thermogravimetric balance. The polymers were found not to be very stable, decomposing to a large degree below 300°C.

The reaction of silicon tetrachloride with aliphatic tetracarboxylic acids has produced only short chain compounds. None of these substances were very stable, decomposition taking place below 200°C.

Organo-aluminum polymers have been prepared through the reactions of, initially a coordination of aluminum with suitable organic reagents, and subsequently a condensation with reagents having hydroxy or carboxylic acid functional groups. 1,1,2,2-tetraacetylethane, napthazarin and 2,5-dihydroxy-p-quinone were prepared and utilized in the chelation reactions of aluminum. The condensing agents 3,3',4,4'-tetrahydroxybiphenyl, 5,5'-methylenedisalicylic acid and 1,2,4,5-tetrahydroxybenzene, were prepared and used in polymerization reactions with the chelated aluminum compounds.

Neutral polymers containing aluminum in the four coordination state were the hoped for products in these polymerizations. The polymers produced appear to contain hydroxy and oxygen bridges in their structures.

The determinations of thermal stability of the polymers show that the stabilities are not very high, decomposition taking place below 300°C.

Microfilm $2.75; Xerox $5.00. 100 pages.

SOME REACTIONS OF PEROXYDISULFURYL DIFLUORIDE

(L. C. Card No. Mic 61-2105)

Jean'ne Marie Shreeve, Ph.D.
University of Washington, 1961

Chairman: George H. Cady

The reactions of peroxydisulfuryl difluoride with several substances have been examined. It has been found that $S_2O_6F_2$ acts either: (1) as an oxygenating agent through the addition of oxygen to the central atom of the reacting species, e.g., with CO, PF_3, SOF_2, $COCl_2$, CCl_4, and S; (2) as a fluorosulfonating agent, e.g., with HgO, KCl, C_5F_8, C_2F_4, ICl and SF_4; or (3) as an oxygenating and fluorosulfonating agent by adding oxygen and fluorosulfonate groups to the central atom, e.g., SOClF, Mo, $Mo(CO)_6$ and Re. Pyrosulfuryl fluoride ($S_2O_5F_2$) is obtained as one of the products in reactions (1) and (3).

Three new fluorosulfonates, octafluorobis(fluorosulfonato)cyclopentane ($C_5F_8(SO_3F)_2$), tetrafluorobis (fluorosulfonato)ethane ($C_2F_4(SO_3F)_2$), and tetrafluorobis (fluorosulfonato)sulfur (VI) ($SF_4(SO_3F)_2$) are produced by direct combination of $S_2O_6F_2$ with perfluorocyclopentene (C_5F_8) and tetrafluoroethylene (C_2F_4) at room temperature and with sulfur tetrafluoride (SF_4) at 128° C, respectively. The melting point, freezing point, heat of vaporization, vapor pressure curve, Trouton constant, density and elementary analysis data are given for each new compound. Structures have been confirmed by mass, nuclear magnetic resonance and infrared spectra. Through comparison of the infrared spectrum of the product with those of the reactants, some of the absorption bands have been identified.

A white solid, dioxobis(fluorosulfonato)molybdenum (VI) ($MoO_2(SO_3F)_2$), is obtained from the reaction of $S_2O_6F_2$ with either molybdenum hexacarbonyl or molybdenum metal. Percentage composition data are given.

Microfilm $2.75; Xerox $3.00. 54 pages.

PREPARATION AND PROPERTIES OF METHOXYSILANES AND METHYL SILYL SULFIDE

(L. C. Card No. Mic 61-2069)

Burt Sternbach, Ph.D.
University of Pennsylvania, 1961

Supervisor: Alan G. MacDiarmid

The primary purpose of this investigation was the preparation and characterization of mixed methyl silyl ethers and thioethers of the types SiH_3OCH_3 and SiH_3SCH_3. A study of the basic properties of these compounds in relation to the pure silicon compounds $(SiH_3)_2X$ where X is O or S, was attempted. All newly prepared compounds were completely identified and characterized. Physical properties such as melting points, vapor pressure equations, Trouton's constants, molar heats of vaporization, boiling points and infra-red spectra, were determined.

A. Preparations.

In an attempt to prepare SiH_3OCH_3 an investigation of the condensation reaction between SiH_4 and CH_3OH was carried out. In the presence of a copper catalyst silane reacted with both liquid and gaseous methanol as follows:

$$SiH_4 + CH_3OH \xrightarrow{Cu} \left.\begin{matrix} H_2Si(OCH_3)_2 \\ HSi(OCH_3)_3 \\ Si(OCH_3)_4 \end{matrix}\right\} + H_2$$

In the absence of a copper catalyst silane was found to react with methanol only when the methanol was present in the liquid phase. In this case only $HSi(OCH_3)_3$ and $Si(OCH_3)_4$ were produced.

Silane and monomethoxysilane were decomposed slowly in the presence of Cu metal.

Cl_3SiOCH_3 was reduced to SiH_4 by $LiAlH_4$ or $LiAlH(t\text{-}OC_4H_9)_3$.

No evidence for the production of SiH_3OCH_3 was obtained in the reactions of SiH_3I with $AgOCH_3$ and $NaOCH_3$.

CH_3OH reacted with the adduct, $SiH_3I{\cdot}N(Me)_3$, at -78° to yield SiH_3OCH_3.

CH_3SH reacted with the adduct, $SiH_3I{\cdot}N(Me)_3$, at 0.0° to yield SiH_3SCH_3. SiH_3SCH_3 was found to undergo a slight chemical change upon standing at room temperature.

B. Chemical Properties of Monomethoxysilane.

SiH_3OCH_3 reacted with I_2 to produce a highly complex mixture of SiH_3I and methoxysilanes.

SiH_3OCH_3 was hydrolyzed quantitatively by pure water to $(SiH_3)_2O$ and CH_3OH.

No evidence for the reaction of SiH_3OCH_3 with SiH_3I or $COCl_2$ was obtained.

SiH_3OCH_3 was found to be completely stable at room temperature, but upon standing at room temperature in the presence of HgI_2, a slight chemical change was observed.

SiH_3OCH_3 did not react violently with air but chemical decomposition did occur.

SiH_3OCH_3 did not react with gaseous methanol but only with liquid methanol as follows:

$$SiH_3OCH_3 + CH_3OH \longrightarrow \left.\begin{matrix} Si(OCH_3)_4 \\ HSi(OCH_3)_3 \\ H_2Si(OCH_3)_2 \end{matrix}\right\} + H_2$$

C. Interactions of Lewis Acids with Monomethoxysilane and Methyl Silyl Sulfide.

No evidence for adduct formation was obtained from the interactions of SiH_3OCH_3 with B_2H_6 or BF_3. With B_2H_6 there was no interaction of any type at -78°. BF_3 reacted with SiH_3OCH_3 at temperatures between -127° and room temperature as follows:

$$BF_3 + SiH_3OCH_3 \longrightarrow SiH_3F + CH_3OBF_2$$

No evidence for any type of interaction was obtained in the case of SiH_3SCH_3 and B_2H_6 at -78°.

It was concluded that the mixed methyl silyl ether and thioether are weaker bases than the pure carbon analogues but are not stronger bases than the pure silicon analogues at least when BF_3 and B_2H_6 are used as reference acids.

No conclusion as to the base strengths of SiH_3SCH_3 relative to that of SiH_3OCH_3 could be reached.

Microfilm $2.75; Xerox $5.60. 113 pages.

STRUCTURAL STUDIES OF THE CHROMIUM (II) HALIDES

(L. C. Card No. Mic 61-1335)

Joseph Walter Tracy, Ph.D.
University of Washington, 1960

Chairman: Norman W. Gregory

Methods were developed for growing and mounting single crystals of the deliquescent chromium (II) halides.

The structure of $CrCl_2$ has been found to be similar to that of $CaCl_2$ except that the chloride ions are closely packed along b, the unique axis, and a marked elongation of the octahedron of chloride ions coordinated about the chromium ion is observed. The latter observation is to be expected from ligand field theory considerations. The space group is Pnmn.

$CrBr_2$ and CrI_2 are isostructural in space group C2/m. The chromium ion is again surrounded by an elongated octahedron, but the octahedra are joined to form layer structures.

The $CrCl_2$ - $CrBr_2$ system has been studied by equilibration at elevated temperatures between hydrogen halides and solid chromium (II) halides. Evidence concerning the position in the system of the structural transition could be inferred from observations on the vapor pressure of the condensed hydrogen halide which had been in equilibrium with the solid sample. X-ray powder patterns of the cooled solid sample also provided evidence on the structures of solid phases. The evidence is consistent with the formation of two solid solutions coexisting only at the transition.

Thirty-two references are appended.

Microfilm $2.75; Xerox $3.00. 56 pages.

REACTIONS OF THE DIAMMONIATES OF DIBORANE AND OF TETRABORANE

(L. C. Card No. Mic 61-1816)

Masanobu Yamauchi, Ph.D.
University of Michigan, 1961

The initial purpose of this investigation was to study the behavior of the $[H_2B(NH_3)_2^+]$ cation in metathesis reactions. In particular, it seemed desirable to synthesize the diammoniates of diborane and tetraborane by metathesis reactions to complete the cycle involved in the earlier structure studies on these two diammoniates. A study of the reactions between HF with $[H_2B(NH_3)_2]B_3H_8$ and with $[H_2B(NH_3)_2]BH_4$ became an integral part of this investigation. This problem arose when it was found that all the known salts of the $[H_2B(NH_3)_2^+]$ cation had properties which would render their separation from the desired diammoniate impractical. It was thought that $[H_2B(NH_3)_2]F$, the expected product of this reaction, would resolve this problem, since most fluoride salts are insoluble in liquid ammonia and the two diammoniates are very soluble. In view of this expected insolubility of $[H_2B(NH_3)_2]F$, a convenient method for isolating the pure diammoniates seemed possible.

The reactions of $[H_2B(NH_3)_2]B_3H_8$ and $[H_2B(NH_3)_2]BH_4$ with HF are different from the reactions of HX (X = $[Cl^-]$, $[Br^-]$, and $[I^-]$) with $[H_2B(NH_3)_2]B_3H_8$ and $[H_2B(NH_3)_2]BH_4$. The reactions of HX with $[H_2B(NH_3)_2]BH_4$ and with $[H_2B(NH_3)_2]B_3H_8$ are known to proceed according to the following equations:

$$[H_2B(NH_3)_2]BH_4 + HX \rightarrow [H_2B(NH_3)_2]X + 1/2\ B_2H_6 + H_2$$

$$[H_2B(NH_3)_2]B_3H_8 + HX + (C_2H_5)_2O \rightarrow [H_2B(NH_3)_2]X + (C_2H_5)_2OB_3H_7 + H_2$$

The reaction of HF with $[H_2B(NH_3)_2]B_3H_8$ and with $[H_2B(NH_3)_2]BH_4$ on the other hand, evolves H_2 rapidly until all the HF had reacted. Instead of $[H_2B(NH_3)_2]F$, $[H_2B(NH_3)_2]BF_4$ is sometimes obtained. This difference in behavior of HF as opposed to that of HX probably lies in the ability of $[F^-]$ to form the very stable $[BF_4^-]$ ion.

Although $[H_2B(NH_3)_2]F$ was not obtained from the HF reactions, the $[H_2B(NH_3)_2]BF_4$, which was isolated, could be used to prepare $[H_2B(NH_3)_2]BH_4$ by the following metathesis reaction:

$$[H_2B(NH_3)_2]BF_4 + LiBH_4 \xrightarrow[-45°C]{(CH_3)_2O} [H_2B(NH_3)_2]BH_4\downarrow + LiB_3H_8$$

$[H_2B(NH_3)_2]BF_4$ can be prepared more conveniently by reacting HBF_4 with $[H_2B(NH_3)_2]B_3H_8$ in ethyl ether.

In ethyl ether the diammoniate of tetraborane is converted to the diammoniate of diborane according to the following equation:

$$[H_2B(NH_3)_2]B_3H_8 + LiBH_4 \underset{-78°}{\overset{0°}{\rightleftharpoons}} [H_2B(NH_3)_2]BH_4\downarrow + LiB_3H_8$$

This reaction reverses at -78°C. The results of other related metathesis reactions and solubility relationships seem to indicate that a strong, low temperature interaction between the $[H_2B(NH_3)_2^+]$ cation and the $[B_3H_8^-]$ anion exists in ethyl ether solution.

The diammoniate of tetraborane was obtained from the diammoniate of diborane according to the following equation:

$$[H_2B(NH_3)_2]BH_4\downarrow + NaB_3H_8 \xrightarrow[-78°C]{(C_2H_5)_2O} [H_2B(NH_3)_2]B_3H_8 + NaBH_4\downarrow$$

In conclusion, the cation $[H_2B(NH_3)_2^+]$ which is known to be present in the diammoniates of diborane and of tetraborane does undergo metathesis reactions similar to other Werner coordination complex cations. In ether solutions, however, solubility relationships alone do not

provide sufficient information for predicting the course or extent of such metathesis reactions. Some interaction like that proposed for $[H_2B(NH_3)_2^+]$ and $[B_3H_8^-]$ must be introduced to explain the results.

Microfilm $2.75; Xerox $5.40. 108 pages.

CHEMISTRY, ORGANIC

PART I. PREPARATION OF INTERMEDIATES IN THE BISCHLER INDOLE SYNTHESIS. PART II. SOME REACTIONS OF OPTICALLY ACTIVE METHYLETHYLPHENYLBENZYLIDENE-PHOSPHORANE.

(L. C. Card No. Mic 61-269)

Arturo Bladé-Font, Ph.D.
University of Kansas, 1960

I. The complexity of 3-alkylindoles obtained by the Bischler method does not go beyond a 3-benzyl group. Most of them are 3-methylindoles containing other substituents on the rings. The aim of this investigation was to prepare several α-anilinoketones capable of undergoing cyclization to more complex 3-alkylindoles. However, most of the syntheses were interrupted at the stage of α-anilinopropanols.

The line of approach was to start with an aniline, cause it to react with epichlorohydrin to produce a substituted chloropropanol, replace the halogen by an alkyl or other group through reaction with the appropriate nucleophilic agent, oxidize the product to an α-anilinoketone and effect its cyclization to a 3-alkylindole.

During the course of this work the ring opening of 3-(N-methylanilino)-propylene oxide (I) with sodium ethoxide and sodium diethyl malonate was the means used to prepare the desired intermediates. The secondary alcohol was found to be the only product of the ring opening reaction of I. The new compounds prepared and successfully characterized were: 1-ethoxy-3-(N-methylanilino)-propan-2-ol (II), 1-ethoxy-3-(N-methylanilino)-propanone (III), 5-(N-methylanilino)-2-carbethoxy-4-hydroxy-γ-valerolactone, 3-(N-methylanilino)-2-hydroxypropylmalonic acid, 5-(N-methylanilino)-4-hydroxy-γ-valerolactone and 1-methyl-3-ethoxymethylindole (IV) (synthesized for comparison purposes).

The oxidation of II to III was accomplished in 55 per cent yield by use of Woodward's modification of the Oppenauer reaction. Attempts to effect conversion of III into IV resulted in formation of tars due to the unstable character of IV itself under the acidic conditions of cyclization.

II. The reported[1] resolution of methylethylphenylbenzylphosphonium iodide (I) has made possible the preparation of optically active phosphoranes and their application to the stereochemical study of displacement reactions at the phosphorus atom of an asymmetric phosphonium cation. It was the aim of this work to prepare such phosphoranes and to investigate their reaction with aldehydes, epoxides and nitriles.

The reaction of (+)-methylethylphenylbenzylidenephosphorane ((+)-II), prepared from (+)-I and phenyllithium, and benzaldehyde was found to be product specific and essentially stereospecific. The products were trans- and cis-stilbene, in a 17 : 1 ratio, and (+)-methylethylphenylphosphine oxide ((+)-III) of 96% optical purity. With (-)-II and benzaldehyde (-)-III of 92% optical purity was obtained.

Due to the steric requirements of the Wittig reaction it may be assumed that (+)-I, (+)-II and (+)-III belong to the same configurational family. If the Wittig reaction takes place with retention of configuration at the phosphorus atom the inevitable conclusion is reached that the alkaline decomposition of phosphonium salts, shown[2] to be stereospecific, occurs with inversion at the phosphorus since (+)-I gives (-)-III in this reaction.

The reaction of (+)-II (or (-)-II) with styrene oxide, at 190-200°, gave seven products: benzylacetophenone, 1,3-diphenylpropan-1-ol, cis- and trans-1,3-diphenylpropene, trans-1,2-diphenylcyclopropane, methylethylphenylphosphine and (+)-III (or (-)-III) which was 32% inverted. The reaction proceeds via an isolable phosphonium betaine (IV) formed by attack of the carbanion of the phosphorane on the terminal carbon of the epoxide ring. The occurrence of inversion at the phosphorus is ascribed to an intermolecular oxyanion attack of intermediate IV on the phosphorus of a second IV molecule.

The reaction of (+)-II (or (-)-II) and benzonitrile gave, after acid or alkaline hydrolysis of the unidentified intermediate, desoxybenzoin and methylethylphenylphosphine oxide which was 70-77% inverted. Failure to obtain the expected 100% inversion seems to be due to a Wittig reaction occurring during the hydrolysis.

In the previous reactions triphenylbenzylidenephosphorane was used as a model compound.

1. K. F. Kumli, W. E. McEwen and C. A. VanderWerf, J. Am. Chem. Soc., 81, 248 (1959).
2. K. F. Kumli, W. E. McEwen and C. A. VanderWerf, ibid., 81, 3805 (1959).

Microfilm $2.75; Xerox $8.00. 171 pages.

ELIMINATION REACTIONS OF PYRAZOLINESULFONAMIDES WITH BASE

(L. C. Card No. Mic 61-1728)

John Joseph Callahan, Ph.D.
University of Michigan, 1961

Representative 4-aryl-2-pyrazoline-3(5)-sulfonanilides have been prepared by the addition reaction of styrene-β-sulfonyl chlorides with diazoalkanes, followed by reaction with arylamines. Their reactions with base resemble those of other pyrazolines containing electronegative groups, which are eliminated easily from pyrazolines with the formation of stable aromatic pyrazoles. Under mild conditions, with dilute base at room temperature, the pyrazolinesulfonanilides undergo carbon-sulfur bond cleavage with the elimination of the sulfonanilide group as sulfite and arylamines, and the formation of pyrazoles. The driving force of these reactions can be attributed to the stabilizing aromatic character of the pyrazoles produced.

Eliminative aromatization has been demonstrated with the N-p-toluenesulfonyl derivative of 4-phenyl-2-pyrazoline-3(5)-sulfon-N-methylanilide. With dilute base at room temperature, the p-toluenesulfonyl group is eliminated in preference to the sulfon-N-methylanilide group; in this case the stable aromatic compound produced is 4-phenylpyrazole-3-sulfon-N-methylanilide.

An attempt was made to define the role of the NH group in these eliminations. An N-methyl derivative of 4-phenyl-2-pyrazoline-3(5)-sulfon-N-methylanilide was prepared by direct alkylation, and subjected to hot alkali. Elimination did not occur. Since the position of the blocking N-methyl group could not be established with certainty, it remains uncertain whether it prevents elimination by removing an "active" hydrogen required for effective attack by base, or by preventing subsequent elimination in the direction necessary for establishment of an aromatic system.

Microfilm $2.75; Xerox $3.80. 68 pages.

A STUDY OF CERTAIN ASPECTS OF THE VON BRAUN REACTION

(L. C. Card No. Mic 60-6849)

Richard David Carlson, Ph.D.
University of Michigan, 1960

The von Braun reaction in which a benzamide of an alkylamine is converted to an alkyl halide and benzonitrile has received little attention as a potential synthetic procedure for converting alkylamines into alkyl halides. It was believed that this was because of the difficulty, often encountered, of separating the alkyl halide from the by-products of the reaction, benzonitrile and phosphorus oxyhalide.

The present investigation was undertaken to explore the use of thionyl chloride in place of phosphorus pentahalides and the use of aliphatic rather than aromatic amides. In addition, two features bearing on the mechanism of the reaction were investigated: the optical course of the reaction and real existence of intermediates originally postulated by von Braun but recently discarded by Leonard and Nommensen.

The results of the investigation disclosed the following:

1. The yields of alkyl halides produced from the reaction of a phosphorus pentahalide with benzamides of aliphatic amines are in the ranges illustrated by the following examples: 1-chloro-4-phenylbutane, 75%; octyl bromide, 70%; 2-(m-tolyl)-ethyl chloride, 50%; cyclopropylmethyl chloride, 30%; 1-chloro-2-phenylpropane, 25% and t-butyl chloride, 0%.

2. The yields of benzyl chlorides produced from the reaction of thionyl chloride with benzamides of benzylamines are in the ranges illustrated by the following examples: benzyl chloride, 20-50%; p-methoxybenzyl chloride, 40-50%; α-methylbenzyl chloride, 80-85%; α-phenylbenzyl chloride, 80-85%; α-cyclopentylbenzyl chloride, 80-85%.

3. The yields of benzyl chlorides produced from the reaction of thionyl chloride with acetamides of benzylamines are in the ranges illustrated by the following examples: benzyl chloride, $< 10\%$; p-methoxybenzyl chloride, 40-50%; α-methylbenzyl chloride, 55-65%; α-cyclopentylbenzyl chloride, 75-85%; and α-phenylbenzyl chloride, 75-85%.

4. The optical activity of the chlorides produced from optically pure N-sec-butylbenzamide, N-(1-phenylethyl)-benzamide and N-(1-phenylethyl)-acetamide decrease in the order given.

5. N-Benzylbenzimidyl chloride and N-methylbenzimidyl chloride have been isolated and characterized, from the reaction of the corresponding amides with thionyl chloride, by carrying out the reaction at a lower temperature than is usual. These benzimidyl chlorides have been decomposed by heat to the usual von Braun reaction products, showing the possibility that these benzimidyl chlorides are real intermediates in the reaction.

Thus, the results of this investigation show that the yields of alkyl halides parallel the accessibility of the α_N-carbon atom to nucleophilic attack, for benzamides in which this carbon is primary and purely aliphatic; they parallel the relative stability of a potential carbonium ion for amides of benzylamines; and they parallel the stabilizing character of the radical in the acyl portion of an amide.

The optical course of the reaction indicates that when the alkyl group affords a relatively stable carbonium ion, extensive racemization occurs. Thus one possible reaction path appears to involve such an ion. However, in the absence of such stabilization, the halide is more likely formed by nucleophilic displacement, and optical activity is largely retained.

When the reaction is carried out in the usual one step manner it appears that the mechanism involves formation of a benzimidyl ester. When the reaction is carried out in a two step manner a benzimidyl halide is formed as an intermediate. Each of these intermediates is partially dissociated into an ion pair. If the anion is a halophosphate or chlorosulfite it at once is decomposed to halide ion and phosphorus oxyhalide or sulfur dioxide, and the halide-cation pair either recombines (if the temperature is low) or decomposes. This decomposition involves either formation of a carbonium ion and nitrile or alkyl halide and nitrile.

Microfilm $2.75; Xerox $6.60. 140 pages.

PROOF OF STRUCTURE OF COMPOUNDS ARISING FROM INTERACTION OF ISOCINCHOMERONYL CHLORIDE AND DIALKYLCADMIUM

(L. C. Card No. Mic 61-1385)

Sterling Frank Chappell III, Ph.D.
The University of Texas, 1960

Supervisor: H. R. Henze

In view of the fact that the chemical literature contains very little report concerning the utility of the organocadmium reagent for the preparation of carbonyl compounds from dibasic acid chlorides, and none concerning interaction of an organocadmium with the dibasic acid chloride of an heterocyclic nitrogen compound, it was decided to carry out an investigation of the reaction of

dialkylcadmiums with the acid chloride of 2,5-pyridinedicarboxylic acid.

One of the side reactions of importance to be considered, when attempting to prepare ketones from organocadmium reagents, is the formation of tertiary alcohols, which result from interaction of "activated" carbonyl groups with the reagent. It was found that when pure isocinchomeronyl chloride (the acid chloride of 2,5-pyridinedicarboxylic acid) interacts with a dialkylcadmium reagent, a 2,5-bis-(dialkylhydroxymethyl)pyridine is formed. There were thus prepared 2,5-di-(2-hydroxy-2-propyl)-pyridine, 2,5-di-(3-hydroxy-3-pentyl)pyridine, and 2,5-di-(4-hydroxy-4-heptyl)pyridine.

When, however, a small amount of thionyl chloride was added to the acid chloride, there was obtained from the interaction of isocinchomeronyl chloride with a typical dialkylcadmium reagent, 5-acyl-2-(dialkylhydroxymethyl)-pyridine in good yield. In this manner, 5-acetyl-2-(2-hydroxy-2-propyl)pyridine, 5-propionyl-2-(3-hydroxy-3-pentyl)pyridine, and 5-butyryl-2-(4-hydroxy-4-heptyl)-pyridine were prepared. The effect of thionyl chloride on the reaction is considered to be one of inhibition of further reaction of the 5-acyl group with excess organocadmium reagent.

The structure of 5-acetyl-2-(2-hydroxy-2-propyl)-pyridine was determined by reducing it with hydriodic acid to form 5-ethyl-2-isopropylpyridine; the latter was also synthesized unambiguously by the following sequence of reactions: oxidation of 5-ethyl-2-methylpyridine with selenium dioxide to form 5-ethyl-2-pyridinecarboxylic acid; esterification to the ethyl ester followed by treatment of the ester with methylmagnesium bromide to yield 5-ethyl-2-(2-hydroxy-2-propyl)pyridine; reduction of the pyridyl alcohol with hydriodic acid to produce 5-ethyl-2-isopropylpyridine. A comparison of the infra-red spectra of these two samples of 5-ethyl-2-isopropylpyridine, prepared by separate routes, showed them to be the same as did also the melting point behavior of the respective picrates.

It was of interest to prepare the structural isomer of 5-ethyl-2-isopropylpyridine, i.e., 2-ethyl-5-isopropylpyridine. This was done in the following manner: 5-isopropyl-2-methylpyridine was prepared by a method reported in the literature; it was oxidized with selenium dioxide to form 5-isopropyl-2-pyridinecarboxylic acid which next was esterified to form the ethyl ester; the latter was brought together with sodium ethoxide and ethyl acetate after which the mixture was treated with dilute hydrochloric acid to prepare 2-acetyl-5-isopropylpyridine; this previously unreported pyridyl ketone was reduced with hydriodic acid to yield 2-ethyl-5-isopropylpyridine.

In the course of the preparation of 5-isopropyl-2-methylpyridine, it was necessary to reduce 2-methyl-5-(2-hydroxy-2-propyl)pyridine with hydriodic acid. There was isolated, in addition to the alkylated pyridine reported, 1,1,2,2-tetramethylethylene-bi-β-(α'-methylpyridine).

From the study undertaken, the utility of organocadmium reagents to form carbonyl compounds has been extended to a dibasic acid chloride of an heterocyclic nitrogen compound, and the structure of the carbonyl compounds formed has been demonstrated.

Microfilm $2.75; Xerox $5.80. 119 pages.

TRANSANNULAR INTERACTION BETWEEN NITROGEN AND MULTIPLE BONDS

(L. C. Card No. Mic 61-101)

Wilmon Blackmar Chipman, Jr., Ph.D.
University of Illinois, 1960

The effect of solvent variation on the infrared and ultraviolet absorption spectra of a series of eight-membered ring aminoketones has been investigated. The aminoketones studied (1-methyl-1-azacycloöctan-5-one, 1-cyclopropyl-1-azacycloöctan-5-one, 1-cyclohexyl-1-azacycloöctan-5-one and 1-p-tolyl-1-azacycloöctan-5-one) exhibited a significantly larger frequency shift in the infrared than did a series of model compounds (cyclohexanone, 1-methyl-4-piperidone and cycloöctanone). The infrared maxima of the meso-cyclic aminoketones in less polar solvents exhibited a strong shoulder at lower frequency; in more polar solvents the shoulder was at higher frequency and the main peak was a lower frequency. The ultraviolet absorption spectra of the same series of aminoketones were obtained in a series of solvents of varying polarity, and in three of the four cases studied a plot of the transition energy versus a standard of solvent polarity (Z) exhibited the linearity and slope characteristic of a charge-transfer transition. 1-Methyl-1-azacycloöctan-5-one, the aminoketone which exhibited the largest solvent variation in the infrared, did not exhibit a linear relationship between the transition energy and the index of solvent polarity. In water this compound was completely transparent in the ultraviolet, even at the higher concentrations at which a saturated ketone or tertiary amine would be expected to absorb. 1-Methyl-1-azacycloöctan-5-one was transparent in the infrared from 2000-1500 $cm.^{-1}$ in deuterium oxide and deuteromethanol.

This study has demonstrated the occurrence of transannular reaction between a tertiary amine and an α,β-unsaturated ketone across a ten-membered ring. No evidence was found for transannular interaction between the same two groups suitably positioned in a ten-membered ring. The product formed on protonation of 5-acetyl-1-azacyclodec-5-ene was not identical with the salt formed by treatment of 1-acetylquinolizidine methiodide (from which the 5-acetyl-1-azacyclodec-5-ene was prepared) with perchloric acid; however, infrared and ultraviolet spectra indicate that the salts of 5-acetyl-1-azacyclodec-5-ene exist in the bicyclic, transannularly-reacted form. A possible explanation of this non-identity is presented.

Microfilm $2.75; Xerox $5.80. 119 pages.

A STUDY OF SILVER CHROMATE OXIDATIONS OF ORGANIC HALIDES

(L. C. Card No. Mic 60-3576)

Lester Adrian Doe, Jr., Ph.D.
University of Pennsylvania, 1960

Supervisor: Frederick V. Brutcher, Jr.

The primary object of this research was to investigate the silver chromate oxidations of organic halides in order

to determine their applicability as a synthetic procedure and deduce the mechanism of the reaction. Emphasis was made on the synthesis of cyclic ketones. The determination of the structural configuration of the cyclopentene ring was another object of this research.

A study was made on the oxidation of cis and trans-cyclopentene-3,5-dione with silver chromate and chromic acid in aqueous acetone. The product, obtained in good yield, was cyclopentene-3,5-dione. Trans-3,4-dibromocyclopentene, proceeding through an allylic rearrangement, gave similar yields of this product. Cyclopenten-1-one-3 was synthesized in high yield through the oxidation of 3-chlorocyclopentene-1. 2-Bromoindanone-1 was synthesized from 1,2-dibromo-indan in excellent yield. The reaction of cyclohexyl bromide with silver chromate gave cyclohexanone plus cyclohexene. The latter compound was formed through an elimination reaction. Trans-1,2-dibromocyclohexane gave principally 2-bromocyclohexanone and cyclopentane carboxylic acid. The ring contracted product was produced through a pinacol type rearrangement. Benzyl chloride was readily oxidized to benzoic acid. The silver chromate method of oxidation offered a new synthesis of carboxylic acids directly from the halide since amyl bromide was readily oxidized to valeric acid.

These oxidations proceed through the following mechanism. The allylic halides form the resonance stabilized carbonium ion which becomes highly solvated with water and then collapses to produce the alcohol. This alcohol reacts with the protonated acid chromate ion to form the protonated chromate ester which decomposes to the ketone. Saturated halides proceed directly to the chromate ester formed through the reaction of the halide with the acid chromate anion. This chromate ester then decomposes to the ketone.

A study was made on the rate of solvolysis of 2-indanyl tosylate. The solvolysis, proceeding by first order kinetics, gave a rate of 2.71×10^{-8} second^{-1} in glacial acetic acid calculated for 25°. This result indicated that the cyclopentene ring present in 2-indanyl tosylate is planar since there was no anchimeric acceleration in the transition state. Hence, cyclopentene probably has a planar or nearly planar configuration. A new synthesis of the nonallylic alcohol of cyclopentene, cyclopenten-1-ol-4 was accomplished. This product was formed by the dehydration of cis-cyclopentane-1,3-diol with fused potassium acid sulfate. Cyclopenten-1-ol-4 will be useful in the further study on the conformation of cyclopentene by studying the solvolysis rate of the tosylate derivative.

Microfilm $2.75; Xerox $9.70. 211 pages.

INVESTIGATION OF ANISYL DERIVATIVES IN SULFURIC ACID

(L. C. Card No. Mic 61-1917)

Robert George Doone, Ph.D.
State University of Iowa, 1961

Chairman: Professor Robert E. Buckles

The behavior of p-anisic acid, 4,4'-dimethoxybenzophenone, trianisylmethylcarbonium perchlorate, tetrakis-(p-methoxyphenyl)-ethylene (TAE), and the TAE-iodine monochloride complex in solutions of near-100% sulfuric acid has been investigated by cryoscopic and spectrophotometric means. In all cases the solutes were found to undergo sulfonation during the course of the measurements.

Extrapolation of the changing i-factors of p-anisic acid to zero time yielded a value of 2, which would be expected on the basis of protonation of the anisic acid by a molecule of sulfuric acid. The average final equilibrium i-value of 3.73 was found to be somewhat lower than that required for a combination protonation and sulfonation (i = 4). This discrepancy could arise from non-ideal behavior of the solute particles, change in the degree of protonation as the degree of sulfonation increased, or incomplete sulfonation. However, some of these possibilities can be minimized because sulfuric acid solutions usually have been found to exhibit ideal behavior at concentration levels used in this investigation (10^{-3} m). Furthermore, no unsulfonated anisic acid was isolated from the freezing-point mixtures. Thus, the low i-value observed is most likely due to a change in the extent of protonation.

The i-factor obtained for 4,4'-dimethoxybenzophenone (i = 5.39) can be rationalized on the basis of a protonation of the carbonyl group followed by an incomplete process of disulfonation. However, analysis of the isolated product indicated that disulfonation had occurred to the extent of 96.5%. On this basis the low i-factor can be explained in terms of incomplete protonation of the carbonyl and methoxy groups. The dimethoxybenzophenone dissolved slowly in sulfuric acid, and i-values could not be obtained sufficiently soon after addition of the compound to the solvent to allow extrapolation of the values obtained to zero time.

Trianisylmethylcarbonium perchlorate yielded an i-factor of 8.01 that could be interpreted on the basis of the formation of perchloric acid immediately upon addition of the perchlorate salt to sulfuric acid followed by incomplete trisulfonation of the trianisylmethylcarbonium ion. Only a trisulfonate presumably contaminated by inorganic sulfate could be isolated.

The visible spectrum of trianisylmethylcarbonium ion in near-100% sulfuric acid solutions underwent rapid changes. Initial bands at 499 mμ and 435 mμ shifted to a band at 483 mμ with a shoulder at approximately 445 mμ. Such a spectral change could be attributed to a shift in equilibrium between isomers of the propeller type suggested by G. N. Lewis or could result from introduction of the sulfonic acid group into the molecule ion with a subsequent decrease in the extent of protonation of the methoxy groups.

The cryoscopic results obtained from TAE-sulfuric acid solutions (i = 13.6) were consistent with the proposed formation of tetrakis (4-methoxy-3-sulfophenyl) ethylene dicarbonium ion. The rapidly shifting absorption band associated with the tetraanisylethylcarbonium ion was located at 505 mμ. In the final spectrum this band was found at 573 mμ and other bands were located at 645, 450, and 405 mμ.

Electron-withdrawing groups present on the aromatic rings of the compounds investigated (either as $-C^+$ or as $-C{=}OH^+$) apparently did not prevent sulfonation, and no evidence was obtained to indicate that any of the rings in those compounds that contained two or more rings behaved

differently toward sulfonation from any of the other rings in the same compound.

Cryoscopic measurements of the TAE-iodine monochloride complex were discontinued when a red-brown deposit presumably iodine monochloride, began to deposit in the joints of the freezing-point cell. A single run yielded an i-factor of 13 at 24 hours. A value of 15 would be expected on the basis of tetrasulfonation of the tetraanisylethylene dicarbonium ion and interaction of the iododichloride ion (ICl_2^-) with sulfuric acid.

Microfilm $2.75; Xerox $7.40. 158 pages.

POLYMERIZATION OF THE VINYL ESTERS OF SOME FATTY ACID DERIVATIVES

(L. C. Card No. Mic 61-1606)

Thomas Karl Dykstra, Ph.D.
University of Illinois, 1961

The homopolymerization of vinyl 4-ketostearate (I), vinyl 9(10)-ketostearate (II), and vinyl 12-ketostearate (III) and their copolymerization with some common comonomers have been studied.

Emulsion homopolymerization of the vinyl ketostearates gives better results than does homopolymerization in bulk and solution systems. It was found that the conversion percentage and the viscosity of the polymer obtained from the emulsion polymerization of III vary considerably depending on the amount of sodium chloride added to the emulsion recipe. All the homopolymers are white, low-melting solids.

One copolymer of vinyl chloride and I (19.9 weight per cent I) and two copolymers of vinyl chloride and III (21.5 and 36.4 weight per cent III) were prepared in emulsion systems and submitted for determination of their mechanical properties. The copolymer of vinyl chloride and I milled into a friable and unplasticized sheet. When compared to copolymers of vinyl chloride and vinyl stearate of similar composition, the copolymers of vinyl chloride and III possess higher milling temperatures, comparable torsional flex temperatures, and higher tensile strengths. For copolymers containing approximately 20 per cent vinyl ester, the vinyl stearate copolymer possesses a higher modulus of elasticity (212,000) than the vinyl 12-ketostearate copolymer (106,000). The opposite is true for copolymers containing approximately 36 per cent vinyl ester in which case the modulus of elasticity of the vinyl 12-ketostearate copolymer (46,400) is ten times that of the vinyl stearate copolymer (4,300). The values of the per cent elongation also compare differently depending on the per cent vinyl ester in the copolymer (150 and 340 per cent for 21.5 and 36.4 per cent III, respectively; 65 and 310 per cent for 19.1 and 35.3 per cent vinyl stearate, respectively). The difference between I and III as internal plasticizers for polyvinyl chloride has been attributed to a positional effect of the keto group. Greater inter-chain association in the copolymers of vinyl chloride and III is probably the reason for their difference in mechanical behavior from similar copolymers of vinyl chloride and vinyl stearate.

The reactivity ratios of the vinyl ketostearates with vinyl acetate (IV), vinylidene chloride (V), vinyl chloride (VI), and acrylonitrile (VII) were determined. The values are as follows: $r_I = 1.18 \pm 0.22$, $r_{IV} = 1.04 \pm 0.02$; $r_{II} = 1.49 \pm 0.25$, $r_{IV} = 1.03 \pm 0.05$; $r_{III} = 1.26 \pm 0.08$, $r_{IV} = 1.07 \pm 0.02$; $r_I = 0.0 \pm 0.17$, $r_V = 3.8 \pm 0.6$; $r_{II} = 0.01 \pm 0.09$, $r_V = 3.7 \pm 0.3$; $r_{III} = 0.0 \pm 0.16$, $r_V = 4.0 \pm 0.5$; $r_I = 0.320 \pm 0.076$, $r_{VI} = 0.874 \pm 0.044$; $r_{III} = 0.248 \pm 0.00$, $r_{VI} = 0.963 \pm 0.00$; $r_{II} = 0.0 \pm 0.091$, $r_{VII} = 2.96 \pm 0.12$; and $r_{III} = 0.0 \pm 0.02$, $r_{VII} = 3.11 \pm 0.03$. These values are of the same order of magnitude as those of various other vinyl esters with the same comonomers, and support the view that the reactivity of a vinyl ester is independent of the nature of its acyl chain.

Microfilm $2.75; Xerox $5.00. 98 pages.

DIELS-ALDER REACTIONS RELATED TO THE SYNTHESIS OF RESERPINE

(L. C. Card No. Mic 60-3657)

John Frederick Herber, Ph.D.
University of Pennsylvania, 1960

Supervisor: Dr. Frederick V. Brutcher, Jr.

The purpose of the problem was to build the D and E rings of the reserpine molecule, the Diels-Alder reaction was used because it gave the correct sterochemistry. The Diels-Alder reaction between glutaconic anhydride and either 2,4-pentadienoic acid, methyl-2,4-pentadienoate and butadiene was unsuccessful. A Diels-Alder adduct was obtained between 2,4-pentadienyl benzoate and maleic anhydride. This adduct, 3-benzoxymethyl-Δ^4-cyclohexene-1,2-dicarboxylic acid anhydride, was opened with ethanol to yield 3-benzoxymethyl-4-carboxy-5-carboethoxy-1-cyclohexene. The structure of this compound was proven and it existed in an all cis configuration. An attempt to chain extend the carboxy group by one carbon atom was unsuccessful.

By reacting 2,4-pentadiene-1-ol with benzyl chloride, the benzyl ether was obtained. A crystalline Diels-Alder adduct was not obtainable between benzyl-2,4-pentadienyl ether and maleic anhydride.

A successful Diels-Alder was obtained between methyl 2,4-pentadienoate and maleic anhydride. The product was cyclohex-5-ene-1,2,3-tricarboxylic acid-1-methyl ester-2,3-anhydride. This anhydride was opened with methanol to yield cyclohex-5-ene-1,2,3-tricarboxylic acid-1,3-dimethyl ester. It was shown that the 1,3-diester was formed instead of the 2,3-diester. The 1,3-diester was hydrogenated to the cyclohexane derivative. This was reacted with diazomethane to yield the triester which was monosaponified to the 2,3 diester. This compound had a different melting point and gave a large melting point depression with the hydrogenated 1,3 diester. Also, to show that no isomerization of a carboxyl group took place, the Diels-Alder reaction between 2,4-pentadienoic acid and maleic anhydride was accomplished. The anhydride was opened with water to yield the tricarboxylic acid. This product was identical with the complete saponification of the triester.

Again the Arndt-Eistert reaction to chain extend the 2-carboxy group by one carbon atom was unsuccessful even though a year's work was involved in trying to make the reaction successful.

Finally a Diels-Alder reaction was obtained between cyclopentenedione-3,5- and methyl-2,4-pentadienoate. The completely enolic product was 4-carbomethoxy-Δ^5-tetrahydroindandione-1,3.

Microfilm $2.75; Xerox $4.80. 92 pages.

POLAROGRAPHY OF SOME METAL IONS IN FORMAMIDE: SIMPLE METAL IONS OF Cr, Mn, Fe, Co, Ni, Cu, Zn AND Cd; FORMATION CONSTANTS OF Pb AND Cd IONS; π-COMPLEXES OF Ti, Cr AND Co.

(L. C. Card No. Mic 60-6444)

Hsiao-shu Hsiung, Ph.D.
University of Cincinnati, 1960

Formamide is a solvent which readily dissolves a large number of inorganic salts as well as organic compounds. It possesses a convenient liquid range, a very low vapor pressure, and its solution has a moderate electrical resistance. Formamide is very easily deoxygenated thus making it a good solvent for use in polarography.

It is the purpose of this work to study (1) the fundamental polarographic characteristics of some transition metal ions in formamide--namely, chromium (III), manganese (II), iron (III), nickel (II), and copper (II); (2) zinc, and cadmium ions; (3) the complex-formation of cadmium ions and lead ions with different complexing-agents; and (4) the polarographic behavior of some π-complexes of certain transition metal ions.

On examining the half-wave potentials of the simple metal ions studied in formamide by using $NaClO_4$ as the supporting electrolyte, they are found to be approximately the same value as those obtained in aqueous medium. However, the diffusion current constants and diffusion coefficients for simple metal ions in formamide are relatively smaller than the comparable values obtained in water. Certainly, this is attributed mainly to the high viscosity of formamide.

Monodentate complexes of cadmium ions with bromide, chloride, iodide, and thiocyanate ions and with thiourea have been carried out in this study. Also, complexes of lead ions with bromide, chloride and iodide ions have been investigated. The studies were done in solutions in which the ionic strength of the system was maintained at one in order to minimize changes in the activity coefficients with composition of the solution. The exception to this was the chloro-complexes in which the ionic strength was 0.64 (limited by the solubility of potassium chloride in formamide). Results revealed the existence of four complexes for the cadmium-thiocyanate system as follows: $Cd[SCN]^+$, $Cd[SCN]_2$, $Cd[SCN]_3^-$, and $Cd[SCN]_4^=$ with successive formation constants of 60, 320, 60 and 6245, respectively; four complexes for the lead-bromide system as follows: $PbBr^+$, $PbBr_2$, $PbBr_3^-$, and $PbBr_4^=$, with successive formation constants of 40, 100, 200, 2154, respectively; two products for the lead-chloride system--namely, $PbCl^+$ and $PbCl_2$ with a value of 40 for K_1 and a value of 746 for K_2. Complexes with a coordination number of four were found for the cadmium-thiourea and the cadmium-halide systems as follows: $Cd[CS(NH_2)_2]_4^{++}$, $CdCl_4^=$, $CdBr_4^=$, and $CdI_4^=$. The instability constants for them are 1.82×10^{-5}, 2.75×10^{-6}, 1.12×10^{-6}, and 6.76×10^{-8}, respectively. Lead ion and iodide ion gave $PbI_4^=$, with a value 4.96×10^{-5} for its instability constant. The stability of complexes formed in formamide, in general, is greater than in water.

By observing the polarographic data of π-complexes of cobalt, chromium and titanium in formamide, it is noted that the π-complexes show a greater stability than the simple ions of the same metals. Nevertheless, the diffusion current constants for the π-complexes studied here are smaller than those of the simple metal ions in the same solvent. The relative order of the half-wave potentials for the π-complexes of the metals reported in this work is in good agreement with the values in other solvents reported previously.

Microfilm $2.75; Xerox $6.40. 133 pages.

THIOACYL AZIDES AND 1,2,3,4-THIATRIAZOLES.

(L. C. Card No. Mic 61-1754)

David Herman Kenny, Ph.D.
University of Michigan, 1961

Since acyl azides show no tendency to cyclize to oxatriazoles, while imidyl azides almost always spontaneously cyclize to form tetrazoles, it was of interest to establish if thiocarbonyl azides would exist as such or as thiatriazoles. To investigate this point, three 5-arylthiatriazoles were synthesized from the dithio acids, thioacylthioglycolic acids, and thiohydrazides.

Diazotization of thiobenzoyl hydrazide gave a good yield of 5-phenyl-1,2,3,4-thiatriazole; the cyclic structure was indicated for this compound by its infrared spectrum, which shows no azide absorption at 2130 cm^{-1}, and by the fact that this compound would not react with Grignard reagents as do azides.

5-Phenyl-1,2,3,4-thiatriazole decomposes when heated, forming molar quantities of nitrogen, elemental sulfur and benzonitrile. At room temperature it resists the action of aqueous alkali, hydrochloric acid, nitric acid and peroxyformic acid; however, concentrated sulfuric acid causes decomposition to produce apparently the same products as are produced by thermal decomposition. 5-Phenyl-1,2,3,4-thiatriazole is easily reduced by lithium aluminum hydride to benzyl mercaptan. 5-Phenyl-1,2,3,4-thiatriazole would not react with chlorine or bromine even under fairly severe conditions; it also failed to react with picric acid or methyl iodide. It is concluded that the thiatriazole sulfur atom is not significantly nucleophilic, and that the thiatriazolyl group on a benzene ring is strongly electron-withdrawing.

5-p-Chlorophenyl- and 5-p-methoxyphenyl-1,2,3,4-thiatriazole were synthesized by diazotization of the corresponding thiohydrazides, which were prepared by the action of hydrazine on the S-thioacyl derivatives of

thioglycolic acid. Thermal decomposition of 5-methoxyphenyl-1,2,3,4-thiatriazole followed the same course as that of 5-phenyl-1,2,3,4-thiatriazole.

Attempts to prepare a representative aliphatic derivative, 5-cyclohexyl-1,2,3,4-thiatriazole, indicated that such compounds are probably unstable at room temperature. Cyclohexanethiocarbonylthioglycolic acid and cyclohexanethiocarbonylhydrazine were successfully synthesized, but diazotization of the latter gave an unstable oil that rapidly decomposed to a nitrile. Conjugation with a benzene ring thus appears to be necessary for the stability of the thiatriazole system.

N-Methylbenzothionhydrazide and N-benzylbenzothionhydrazide were prepared by treating methylhydrazine and benzylhydrazine, respectively, with S-thiobenzoylthioglycolic acid; both formed p-nitrobenzal derivatives readily, showing that acylation had occurred at the substituted nitrogen atom. N-Methylbenzothionhydrazide did not cyclize when treated with nitrous acid, but gave N-methylthiobenzamide.

Microfilm $2.75; Xerox $3.00. 58 pages.

THE SYNTHESES AND GEOMETRY OF 2-HALO-3-ALKYL- AND ARYLCYCLOPENTANONES

(L. C. Card No. Mic 61-2045)

Morton Kramer, Ph.D.
University of Pennsylvania, 1961

Supervisor: Frederick V. Brutcher, Jr.

A general method has been developed for the preparation of mono-α-halo-3-alkyl- and arylcyclopentanones, under equilibrating conditions. The success of this method depends, to a great extent, on the precise control during halogenation afforded by infrared spectrophotometry. It has been demonstrated that this method can be successfully applied to the preparation of higher halogenated-3-alkyl- and arylcyclopentanones. It is apparent that many α-haloketones which have not previously been described or are extremely difficult to prepare, can be prepared utilizing this procedure. The availability of additional compounds of this nature should materially aid the many conformational studies based on the α-haloketones. Under the prescribed conditions, it has been demonstrated that the 2-position is the predominant position of halogenation in 3-alkyl- and arylcyclopentanones.

Fermi resonance or peak-splitting has been shown to be a useful adjunct in determining the position of the double bond in 3-alkyl- and aryl-2-cyclopentene-1-ones. Hence, the position of halogenation in cyclopentanones of this type can easily be determined through the usually facile elimination of hydrogen halide.

The preponderant formation of cis-chlorohydrin upon sodium borohydride reduction of 2-chloro-3-t-butylcyclopentanone indicates that reductions of similar compounds can materially aid in resolving the question of steric or thermodynamic control in reductions of this nature.

Additional spectral evidence has been obtained which verifies the proposed quasi-axial nature of the α-halogens in compounds which would be expected, by the nature of the torsional forces action about their carbon-carbon bonds, to assume the cyclopentane half-chair structure.

The spectral evidence obtained indicates that the steric requirements of a 3-methyl group (the smallest substituent studied) are sufficient to render one conformation of the 2-halo-3-alkyl- and arylcyclopentanones.

Utilizing spectral evidence, it has been possible to tentatively assign a 2,5-dibromo-3-phenylcyclopentanone structure to the dibrominated-3-phenylcyclopentanone obtained under the specified conditions.

Microfilm $2.75; Xerox $6.20. 126 pages.

SOME ACYLATIONS AND ALDOL TYPE CONDENSATIONS INVOLVING DICARBANIONS OF β-DIKETONES. CERTAIN CYCLIZATIONS.

(L. C. Card No. Mic 61-1444)

Robley Jasper Light, Ph.D.
Duke University, 1961

Supervisor: Charles R. Hauser

Several β-diketones were aroylated at the terminal methyl group with aromatic esters by means of two molecular equivalents of potassium amide in liquid ammonia to form 1,3,5-triketones. The triketone from 2-acetylcyclohexanone and methyl benzoate evidently consisted of two isomeric forms, which were interconvertible. The triketones were cyclized with acid to form 4-pyrones, and with ammonia or methylamine to give 4-pyridones. These reactions furnish convenient methods of synthesis of such compounds. Mechanisms are considered.

The terminal carbanion of dipotassiobenzoylacetone and dipotassioacetylacetone underwent addition reactions with the carbonyl group of certain ketones having no α-hydrogen to form the corresponding hydroxy-β-diketones. While dipotassiobenzoylacetone apparently ionized the α-hydrogen of acetophenone, dilithiobenzoylacetone underwent the addition reaction with this ketone and with cyclohexanone to form the hydroxy-β-diketones. Acid catalysed dehydrations of these compounds produced corresponding unsaturated β-diketones and, in certain cases, also an isomeric product that appeared to be the dihydropyrone. Certain of the dihydropyrones were converted to the unsaturated β-diketones with ethanolic potassium hydroxide or methanolic hydrochloric acid, and each dehydration product yielded a mixture of the two isomers with cold sulfuric acid. A hydroxy-β-diketone and its unsaturated β-diketone were cyclized with hydrazine to form the corresponding pyrazoles. The former pyrazole was dehydrated to give the latter. A hydroxy-β-diketone underwent cleavage with potassium t-butoxide in t-butanol to regenerate the ketone and β-diketone. Equilibrium factors are considered.

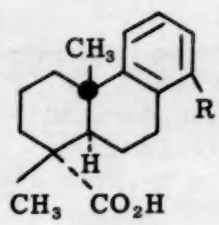
1,5-Diphenyl-1,3,5-pentanetrione was cyclized with ethyl oxalate by means of sodium ethoxide in refluxing ethanol to produce 3,5-dibenzoyl-1,3,4-cyclopentanetrione. This compound was cyclized with o-phenylenediamine to form 1,3-dibenzoyl-2-oxo-cyclopentene[4,5-b]quinoxaline. The structure of the quinoxaline was confirmed by oxidation to form pyrazinetetracarboxylic acid, an authentic sample of which was obtained from the oxidation of phenazine. Microfilm $2.75; Xerox $4.80. 94 pages.

APPROACHES TO THE SYNTHESIS OF PIMARIC ACID

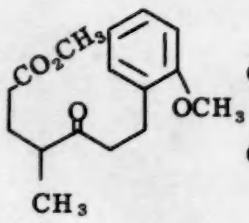
(L. C. Card No. Mic 61-1764)

James Arthur Marshall, Ph.D.
University of Michigan, 1961

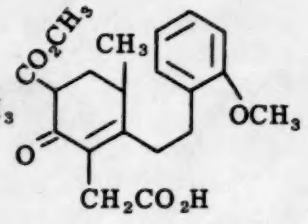
Several synthetic approaches to the pimaric acid skeleton were investigated. These approaches had as their immediate goal, the intermediate (I, R=OCH_3 or R=H). Toward this end, the keto ester (II) was prepared by the application of a new β-keto ester synthesis.



(I)



(II)

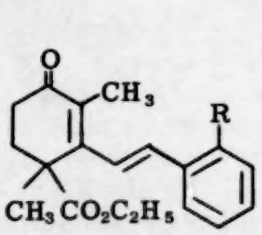


(III)

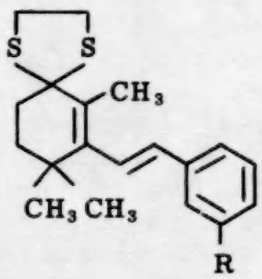
Thus, it was found that when ethyl hydrogen methylmalonate was treated with magnesium ethoxide, isopropylmagnesium bromide, or methylmagnesium bromide, a stable magnesium chelate resulted. This chelate was acylated in tetrahydrofuran with various acid chlorides in order to test the scope of the reaction. These acylations proceeded with evolution of carbon dioxide and led to 47-79% yields of α-methyl-β-keto esters. The corresponding chelate from ethyl hydrogen phenylmalonate could be acylated in 34-65% yields to give the corresponding α-phenyl-β-keto esters.

Attempts to convert the keto ester (II) to the dicyclic acetic acid (III), via the Stobbe-Dieckmann sequence led to a 1,3-dione which arose from an intramolecular condensation of the keto ester (II). This dione was characterized, and the route was abandoned.

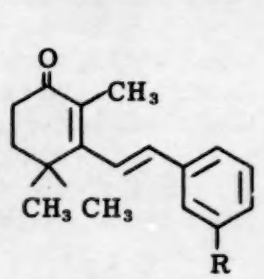
The tricyclic acid (I) was next approached from the dienones (IV, R=OCH_3 or R=H) prepared by a Michael-aldol reaction sequence with ethyl vinyl ketone on the corresponding β-keto esters. The removal of the ketone function of (IV, R=OCH_3) was frustrated by polymerization



(IV)



(V)



(VI)

of the expected diene under the conditions required for desulfurization of the thioketal derivative of (IV).

The thioketals (V, R=H) and (V, R=OCH_3) were synthesized for use as model compounds to study desulfurization of thioketal derivatives similar to those of (IV). The desulfurization reaction was found to lead to reduction of the styrene double bond with W-2 Raney nickel in ethanol. The use of deactivated Raney nickel in acetone led to dimeric dienes.

The dienone (VI, R=OCH_3) was converted to a hydrophenanthrene which has been converted to dl-totarol. This constitutes a formal total synthesis of dl-totarol.

Microfilm $2.75; Xerox $5.00. 100 pages.

ABNORMAL OXIDATION OF HYDRAZINES

(L. C. Card No. Mic 61-1268)

Nicasio P. Marullo, Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: C. G. Overberger

The oxidation of several 2,6-disubstituted-N-aminopiperidines and the hydrosulfite reduction of N-nitroso-2,6-diphenylpiperidine have been previously shown to proceed with a high degree of stereospecificity to yield substituted cyclopentanes.

The primary object of this research was to prepare an optically active linear 1,1-disubstituted hydrazine and nitrosamine and determine the stereochemistry of the nitrogen elimination reaction of these compounds. A successful method for the preparation of optically pure N-nitroso-α,α'-dimethyldibenzylamine and the corresponding N-amino compound was achieved.

Oxidation of N-amino-α,α'-dimethyldibenzylamine with yellow mercuric oxide did not proceed with complete stereo-retention of configuration of the benzyl carbons to give a single enantiomer of 2,3-diphenylbutane. There was, on the contrary, isolated considerable amounts of meso-2,3-diphenylbutane and a mixture of isomers the optical rotation of which was considerably less than the optical rotation of what is considered to be optically pure 2,3-diphenylbutane. Approximately the same results were found upon reduction of optically active N-nitroso-α,α'-dimethyldibenzylamine.

In order to elucidate further the mechanism of these reactions, unsymmetrically substituted 1,1-dibenzylnitrosamines were prepared and decomposed to determine if fragmentation occurs. The compounds prepared were N-nitroso-3-aminodibenzylamine and N-nitroso-3-amino-α,α'-dimethyldibenzylamine. Reduction of these compounds with sodium hydrosulfite proceeded with theoretical nitrogen evolution to give a high yield of the unsymmetrical bibenzyls and no detectable amount of cross-over product. These results demonstrated that, if fragmentation occurred, the fragments are effectively trapped within a solvent cage.

Attempts to determine if the observed racemization of the linear optically active compounds was due to fragmentation and subsequent loss of tetrahedral character or whether the reactive diazo-like intermediate racemized prior to its concerted collapse were not successful. Oxidation of 1,1-dibenzylhydrazine, under conditions similar to those where it had been previously shown that the diazo intermediate of simple aliphatic 1,1-disubstituted hydrazines was stable and the original hydrazine regenerated by addition of reductant, was found instead rapidly to proceed to products.

In order to determine if the same nitrogen elimination reaction was operative in a difunctional nitrosamine, a single isomer of 1,4-dinitroso-2,3,5,6-tetraphenylpiperazine

was prepared by catalytic reduction of the corresponding dihydropyrazine. Nitrosation in dioxane solution gave the desired dinitrosamine. Reduction of this compound with sodium hydrosulfite, however, gave only a 51% yield of the theoretical nitrogen, making product identification experimentally unfeasible.

Microfilm $2.75; Xerox $4.20. 77 pages.

THE SYNTHESIS OF SOME ONE-SUBSTITUTED AND ONE, TWO-DISUBSTITUTED BENZIMIDAZOLES.

(L. C. Card No. Mic 60-3672)

Howard Matrick, Ph.D.
University of Pennsylvania, 1960

Supervisor: Allan R. Day

Several types of benzimidazole derivatives have been prepared as potential pharmaceuticals.

Some 1-(2-phenylethyl)benzimidazoles have been prepared as potential adrenergics. The method consisted of condensing β-phenethylamine and 4-substituted-2-nitrochlorobenzenes. These were reduced and the corresponding diamines reacted with formic acid to produce 5-substituted 1-(2-phenylethyl)benzimidazoles.

Some 2- and 2,8-substituted 1,2,3,4-tetrahydropyrazino-[1,2-a]benzimidazoles were prepared as potential analgesics. This involved condensing 4-substituted-2-nitrochlorobenzenes with ethanolamine. The o-nitroamines were reduced, ring closed with glycolic acid and the diols chlorinated. The dichlorides were reacted with primary amines to give the desired products. Evidence for the structure of these compounds was given so as to distinguish them from some structural isomers.

3-Carbethoxy-3-phenyl-1,2,3,4-tetrahydropyrido-[1,2-a]benzimidazole was prepared as a potential analgesic. This involved reacting phenylacetonitrile with 1-(2-chloroethyl)-2-chloromethylbenzimidazole. The nitrile was hydrolysed to the acid. Esterification gave the final product.

Several other benzimidazole derivatives have been prepared.

The infrared spectra of all new compounds were given. The ultraviolet spectra of many new compounds were given.

Microfilm $2.75; Xerox $5.60. 115 pages.

A STUDY OF THE DIELS-ALDER REACTION OF TETRACYCLONE AND METHYL ARYLPROPIOLATES

(L. C. Card No. Mic 61-1267)

Demetreos N. Matthews, Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: Ernest I. Becker

The kinetic study of the Diels-Alder reaction of tetracyclone (tetracyclopentadienone) and the methyl esters of arylpropiolic acids is a continuation of the work of Benghiat and Becker who investigated the electronic effects in the above system. The study was extended in order to help elucidate the mechanism of the Diels-Alder reaction. Although a great deal of scientific effort has been expended on elucidation of the mechanism, strong controversy still exists.

The specific aims of this Dissertation were: (1) the preparation of ortho-substituted arylpropiolic acids and their methyl esters, together with some acids and esters previously prepared by Benghiat; (2) the determination of the rates of reactions of the methyl arylpropiolates with tetracyclone at various temperatures to allow calculation of activation energies and frequency factors; (3) the measurement of the apparent dissociation constants; (4) the use of the above data in interpreting the mechanism of the reaction; and finally (5) the use of the data to establish the presence of an ortho effect and to explain its origin.

The substituted phenylpropiolic acids and their methyl esters were prepared essentially according to procedures already available in the literature. Apparent dissociation constants in 50 volume-percent ethanol were determined potentiometrically. The pK_a values were calculated from the equation

$$pK_a = pH - \log \frac{salt - H^+}{acid - H^+}$$

A plot of log K/K_o of the dissociation constants of the m and p substituted phenylpropiolic acids against Hammett's sigma values and of the log K/K_o values for the ortho-substituted phenylpropiolic acids against Taft's $*$values (corrected to read zero for the phenylpropiolic acids) indicated either the values of Taft are not strictly comparable with the Hammett values or that an abnormal ortho effect is present.

The reaction rates were determined by measurement of the volume of carbon monoxide evolved under constant pressure. The final readings were calculated values. The reactions were found to be second order to over 90% completion.

The results of the investigation can be summarized as follows:

1) The reaction of tetracyclone and methyl arylpropiolates has as the rate-determining step the formation of the complex rather than its breakdown.

2) The Leffler plot (ΔE_A versus log A) gives an isokinetic temperature of 262.2° if the ortho and para nitro values are excluded. The closeness of the values would lead one to predict a non-ionic transition state.

3) The curvature in the Hammett type plot where log k is plotted against log K_i/K_i° for the arylpropiolic acids can be eliminated if log K_i/K_i° values for phenols (σ^- values) are used. The curvature can thus be ascribed to extra resonance interactions between the substituent and the reaction site.

4) An abnormal ortho effect is present in this reaction. The absence of the effect when log K/K_o values for phenols are used lends credence to the postulate of Roberts that the effect is due to a "field" effect. As predicted by models no steric effect can be detected.

5) As a sidelight it is shown that the infrared and ultraviolet spectra of the methyl arylpropiolates do not show any correlation with their corresponding rate constants for the Diels-Alder reaction.

The application of the above facts to the Diels-Alder

mechanism would lead one to propose a mechanism where there is an initial attack at only one site but where the formation of the second bond begins before the first bond has been completely formed. This would explain the presence of extra resonance factors and the fact that polar factors govern product formation. It is evident that in certain cases the two extreme possibilities can occur. The first would be a truly cyclic mechanism where polar factors are relatively unimportant and the bond-forming reactions proceed simultaneously. The second would be a two-step reaction where one bond forms first followed by the formation of the other bond in a second distinct step. Microfilm $2.75; Xerox $6.00. 122 pages.

CARBONIUM ION STABILITY AND THE HYDRIDE ION TRANSFER REACTION

(L. C. Card No. Mic 61-1326)

Leslie Marvin McDonough, Ph.D.
University of Washington, 1960

Chairman: Hyp J. Dauben, Jr.

Six triarylmethyl perchlorates and six triarylmethanes have been prepared. Di-p-anisylmethane and previously unreported di-p-anisylmethyl perchlorate and tropenium perchlorate were also prepared. It was found that the methods reported for syntheses of some of these compounds had serious drawbacks and these methods have been improved. Also previously unreported properties have been determined and are presented.

Most of the hydride ion transfer reactions possible with this combination of compounds were investigated.

$$R_3C^+, ClO_4^- + R_3CH \rightarrow R_3CH + R_3C^+, ClO_4^-$$

The purpose was to test the feasibility of determining equilibrium constants for these reactions. Such equilibrium constants would provide a quantitative measure of carbonium ion stability. For the arylmethyl systems studied however, equilibria could not be established since when the carbonium ions are of comparable stability the reactions are prohibitively slow and could not be accelerated by heating since this caused decomposition. It has been proposed that one of the main reasons for the slowness of these reactions and the extreme speed of another reaction of small driving force is the fact that the carbonium ions for the slow reactions are solvated by a polar solvent while no polar solvent was present for the other reaction.

The applicability of the hydride ion transfer reaction which has been previously demonstrated to be the best or only method of preparation for tropenium ion salts, tropenium-metal carbonyl complex ion salts, and perinaphthenium ion salts has been extended to include two new classes of salts, triarylmethyl perchlorate salts and triarylcyclopropenium perchlorate salts.

The hydride ion transfer reaction has been used to demonstrate that the stability of the s-triphenylcyclopropenium cation is intermediate between tropenium and tri-p-anisylmethyl cations.

Linear free energy relationships have been demonstrated for two series of reactions, i. e. cycloheptatriene with di- and triarylmethyl perchlorate salts and triphenylmethyl perchlorate with triarylmethanes, but could not be established for tri-p-anisylmethane with arylmethyl perchlorate salts because of the extreme scatter for the points. The relative rates of tri-p-tolylmethyl perchlorate with isomeric mixtures of three substituted cycloheptatrienes have been determined and the relative rates have been interpreted in terms of isomer content.

The determination of the deuterium isotope effect with tri-p-anisylmethane was attempted. It was demonstrated that failure to accurately determine the k_H/k_D for this reaction and the previously mentioned failure to demonstrate a linear free energy relationship when tri-p-anisylmethane was the hydride ion donor are due to a side reaction caused by a decomposition product of tri-p-anisylmethane. The deuterium isotope effect has been successfully determined for cycloheptatriene with triphenylmethyl perchlorate (k_H/k_D = 3.8) and with di-p-anisylphenylmethyl perchlorate (k_H/k_D = 5.0). On the basis of these values it has been proposed that either hydride ion transfer reactions do not proceed by attack of the cation perpendicular to the C-H bond (as proposed by other workers on the basis of deuterium isotope effects) or that deuterium isotope effects cannot be used as a criterion of this mechanism.

The discussion considers the factors which determine the rate of hydride ion transfer and considers mechanism in general. Arguments are presented for the proposal that the ρ for a reaction series, where the hydride ion donor is constant and the carbonium ion salts are varied, determines the relative stability of the carbonium ion derived from the hydride ion donor when compared to similarly determined ρ values. Also discussed is the possibility of correlating the rates of these reactions with carbonium ion stability as calculated by the simple L. C. A. O. molecular orbital method.

Microfilm $2.75; Xerox $8.20. 176 pages.

SOME ALKYLATIONS AND CONJUGATE ADDITIONS INVOLVING DIANIONS

(L. C. Card No. Mic 61-1449)

Robert Bruce Meyer, Ph.D.
Duke University, 1961

Supervisor: Charles R. Hauser

The generality of the alkylation of the dicarbanion of acetylacetone was investigated. Good yields of terminal alkylation products were obtained when the dicarbanion was treated with primary alkyl halides, but only a fair yield was obtained with isopropyl bromide. Tertiary butyl chloride failed to alkylate the dicarbanion. Benzhydryl chloride and β-phenylethyl chloride gave tetraphenylethylene and styrene respectively when treated with the dicarbanion. Both mono- and symmetrical dialkylation products were obtained with n-octyl bromide. Benzylation of dipotassio-o-hydroxyacetophenone gave exclusively 2,2-dibenzyl-2′-hydroxyacetophenone. Terminal alkylations of the dicarbanions of other β-diketones were also realized. Mechanisms and synthetic applications are indicated.

The condensation of disodio phenylacetic acid with ethyl cinnamate was studied extensively. When the reaction was neutralized directly or indirectly with ammonium chloride, or by pouring an ethereal suspension of the adduct into dilute hydrochloric acid approximately equal amounts of the two diastereomeric 4-carbethoxy-2,3-diphenylbutyric acids were obtained in high yields. When neutralized by adding water to an ethereal suspension of the adduct the diastereomeric 2,3-diphenylglutaric acids were obtained. The configurations of the 4-carbethoxy-2,3-diphenylbutyric acids were established. The ester-acids, as well as those of glutaric and 3-phenylglutaric acid, underwent rapid hydrolysis in cold sodium hydroxide solution. Disodio phenylacetamide gave 2,3-diphenylglutarimide when condensed with ethyl cinnamate. The condensations of disodio 2-phenylacetanilide and disodio N-methyl-2-phenylacetamide with ethyl cinnamate are also reported. The mechanisms and stereochemistry of the condensations are discussed.

Disodio phenylacetamide, prepared by means of two molecular equivalents of sodium amide in liquid ammonia, was alkylated with several alkyl halides to give α-alkylphenylacetamides. Good yields were obtained with n-butyl bromide and benzyl chloride, and a fair yield with β-phenylethyl chloride. Alkylation with α-phenylethyl chloride gave only one diastereomeric form of 2,3-diphenylbutyramide in fair yield. Benzhydrylation (19%) was accompanied by the formation of tetraphenylethylene (50%). Butylation and β-phenylethylation of phenylacetic acid at the α-carbon are also reported.

Microfilm $2.75; Xerox $5.40. 110 pages.

REACTION OF FLAVYLIUM PERCHLORATE WITH PRIMARY AROMATIC AMINES

(L. C. Card No. Mic 61-1932)

Franklin Luckenbill Montgomery, Ph.D.
State University of Iowa, 1961

Chairman: Professor Ralph L. Shriner

The reaction of flavylium perchlorate with p-toluidine resulted in the formation of two products in which the flavylium nucleus and the p-toluidine combined in ratios of one to one and one to two. The compound in which the ratio was one to one resulted from the alkylation of the amino group of the p-toluidine at the four position of the flavylium nucleus. Treatment of this 4-(4-methylanilino)-2-phenyl-1,4-benzopyran with anhydrous perchloric acid resulted in the formation of flavylium perchlorate. Treatment of the flavene amine with benzoyl chloride, acetic anhydride and phenyl isocyanate also resulted in a cleavage of the carbon nitrogen bond to give the adducts of p-toluidine with the corresponding reagents.

Reduction of the imine, formed by the reaction of 4-thioflavone methiodide with p-toluidine, was carried out with palladium on Norite and hydrogen at elevated temperatures. Reaction, however, did not stop with the formation of the amine, but continued, resulting in the cleavage of the compound. The formation of the flavene amine was accomplished by the reduction of the imine with sodium amalgam in absolute ethanol.

The compound resulting from the reaction of p-toluidine and flavylium perchlorate which had a ratio of two to one was not characterized. It was believed to result however, from the oxidation of the 4-(4-methylanilino)-2-phenyl-1,4-benzopyran at the four position and the loss of water to give the corresponding imine. A 1,4- addition of another mole of p-toluidine across the conjugated system would result in a product in which the ratio of p-toluidine to the flavylium nucleus was two to one.

Treatment of 2,4-dimethylaniline and N-methyl-p-toluidine with flavylium perchlorate resulted in the formation of products in which the ratio of the flavylium nucleus to the amine was one to one. The amine combined with the flavylium perchlorate through the amino group at the four position of the flavylium nucleus to give the corresponding flavene amines. Upon treatment of these amines with anhydrous perchloric acid, flavylium perchlorate was regenerated. The reduction of 4-(2,4-dimethylphenylimino)-2-phenyl-1,4-benzopyran to the flavene amine was accomplished with sodium amalgam and absolute ethanol.

No product was isolated from the reaction of flavylium perchlorate and p-anisidine which had a ratio of the amine to the flavylium nucleus of one to one. A product was isolated in which the ratio of the amine to the flavylium nucleus was two to one. This compound was believed to be formed in the same manner as the corresponding compound from the reaction of flavylium perchlorate with p-toluidine. The ultraviolet spectra of the two compounds were similar.

The reaction of aniline with flavylium perchlorate resulted in the formation of a compound in which the attack of the flavylium nucleus took place on the ring of the aniline para to the amino group. This compound was readily oxidized by the air to the corresponding carbinol. Reduction of the imine of aniline and flavone resulted in a flavene amine. No product was isolated from the reaction of aniline and flavylium perchlorate which corresponded to this flavene amine.

No reaction took place when mesidine or N-methyl-2,4-dimethylaniline was treated with flavylium perchlorate under varying conditions. The steric hindrance of the methyl groups at the nitrogen of both amines and the carbon atom ortho to the amino group of the N-methyl-2,4-dimethylaniline was sufficient to prohibit any reaction from taking place.

Microfilm $2.75; Xerox $3.80. 69 pages.

THE SOLVOLYSIS OF 4,4-DIMETHYLCHOLESTERYL p-TOLUENESULPHONATE AND AN INVESTIGATION OF CERTAIN 3,5-CYCLOSTEROIDAL DERIVATIVES OF PHYSIOLOGICALLY ACTIVE ADRENAL CORTICAL STEROIDS.

(L. C. Card No. Mic 60-5027)

Robert M. Moriarty, Ph.D.
Princeton University, 1959

Two main problems were studied in the course of this research program. The first dealt with the preparation of 3,5-cyclo-6-one derivatives of physiologically

active steroidal hormones. 3,5-Cyclopregnane-6,11,20-trione-17,21-diol acetate was prepared by the following synthesis:

Cortisone was converted to 17α,20,20,21-bismethylenedioxy-4-pregnene-3,11-dione. By enol acetylation of this compound, 17α,20,20,21-bismethylenedioxy-3,5-pregnadiene-11-one-3-ol acetate was prepared. Selective reduction of this ester yielded 17α,20,20,21-bismethylenedioxy-5-pregnene-3β,11-diol and 17α,20,20,21-bismethylenedioxy-5-pregnene-11-one-3β-ol. By tosylation of the corresponding alcohol, 17α,20,20,21-bismethylenedioxy-5-pregnene-11-one-3β-ol p-toluenesulphonate was obtained. This ester was hydrolyzed under "i-steroid-forming" conditions to yield 17α,20,20,21-bismethylenedioxy-3,5-cyclopregnane-6-ol-11-one, which was oxidized to 3,5-cyclopregnane-6,11-dione. Removal of the side-chain protecting group followed by acetylation yielded 3,5-cyclopregnane-6,11,20-trione-17α,21-diol-acetate. Also in this study, 3,5-cyclopregnane-6,20-dione, 3,5-cyclo-16-pregnene-6,20-dione and 3,5-cycloandrostane-6,17-dione were made by oxidation of the corresponding 3,5-cyclo-6-ol-sterol resulting from the i-steroid rearrangement in each case. All these compounds were submitted for physiological testing for anti-inflammatory activity.

The second part of this investigation was a study of the solvolysis of 4,4-dimethylcholesteryl p-toluenesulphonate. The methanolysis, acetolysis, and hydrolysis of this compound were studied. In the case of the hydrolysis in 60% aqueous acetone in the presence of potassium acetate (conditions which cause choiesteryl p-toluenesulphonate to rearrange to 3,5-cyclocholestane-6β-ol) no 3,5-cyclosterol was formed. Nearly 70% of the total product was a mixture of isomeric, conjugated dienes; 20% was identified as 3-isopropanol-A-norcholest-5-ene; also, 7% of 4,4-dimethylcholesterol was found. The rate of hydrolysis was about 7 times faster than that of cholesteryl p-toluenesulphonate. A preliminary investigation of the preparation of 4-methylcholesterol was also undertaken.

Microfilm $2.75; Xerox $6.40. 131 pages.

ANGULAR ALKYLATION BY CLAISEN-TYPE REARRANGEMENTS

(L. C. Card No. Mic 61-285)

Ivan Conrad Nordin, Ph.D.
University of Kansas, 1960

Application of the Claisen rearrangement to vinyl ethers of suitably constituted polycyclic allylic alcohols provides a new, stereospecific route to angularly substituted ring systems (1). Since the rearrangement is an intramolecular process, the new carbon-carbon bond which is produced in the reaction is necessarily formed on the same side of the ring system as the carbon-oxygen bond that undergoes cleavage.

In model cyclohexenyl systems the related Cope rearrangement (2) led to extensive elimination with the formation of cyclohexadienes and acetone, as well as carbondioxide. However, the Claisen rearrangement of the vinyl ethers of these same alcohols furnished the corresponding cyclohexenyl acetaldehydes in better than 90% yield, with little or no attendant elimination. Claisen rearrangement of the vinyl ethers of appropriate fused-ring allylic alcohols such as $\Delta^{9(10)}$-octalol, Δ^{4}-cholestene-3β-ol and 17β-acetoxy-17α-methyl-Δ^{4}-androstene-3β-ol was then tested to demonstrate the feasibility of the reactions in polycyclic systems.

These alcohols are vinylated conveniently by the mercuric acetate-catalyzed vinyl transetherification procedure of Watanabe and Conlon (3). The resulting purified vinyl ethers, on being heated at 190-195° for one or more hours in an inert solvent, rearrange cleanly and in good yield to the corresponding angularly substituted formylmethyl derivatives.

The γ,δ-unsaturated formylmethyl derivatives resulting from the rearrangement were in each case characterized in a variety of ways. In addition to the usual spectral evidence and the preparation of carbonyl derivatives, the aldehydes were oxidized with silver oxide to the corresponding γ,δ-unsaturated acids, which in turn were converted to δ-iodo-γ-lactones. In two cases the formyl methyl function was reduced to an ethyl group.

Preliminary experiments on the interruption of aromaticity by the Claisen rearrangement of aromatic vinyloxymethyl compounds having allylic double bond character ranging from 1/2 to 4/5 as defined by Pauling (4) were also performed.

(1) A. W. Burgstahler and I. C. Nordin, J. Am. Chem. Soc., 81, 3151 (1959).

(2) W. Kimel and A. C. Cope, J. Am. Chem. Soc., 65, 1992 (1943) and later papers.

(3) W. H. Watanabe and L. E. Conlon, J. Am. Chem. Soc., 79, 2828 (1957).

(4) L. Pauling, "Nature of the Chemical Bond," 200, Cornell University Press, Ithaca, N. Y. 1960.

Microfilm $2.75; Xerox $5.00. 98 pages.

PART I. SOME POLYMERIZATION REACTIONS OF THE ACRYLATE AND METHACRYLATE ESTERS OF ALCOHOLS FROM SIMMONDSIA CHINENSIS SEED OIL. PART II. POLYMERIZATION REACTIONS OF SOME ORGANOPHOSPHOROUS COMPOUNDS.

(L. C. Card No. Mic 61-1655)

David Mearns Paisley, Ph.D.
University of Illinois, 1961

PART I

The acrylate and methacrylate esters of the mixed alcohols, primarily n- eicos-11-enol and n-docos-13-enol, from the seed oil (known commonly as jojoba oil) of Simmondsia chinensis have been synthesized and homopolymerized and copolymerized in the pattern of other acrylate and methacrylate esters. Free radical initiation in an emulsion system produces soluble polymers in which the unsaturation of the alcohol chain has been almost completely retained, although exposure to air renders the polymers cross-linked and insoluble.

PART II

Anionic initiators have been employed for the first time to effect the copolymerization of a vinyl phosphonic acid ester. Methyl 1-propene-2-phosphonate and styrene produce, under the influence of n-butyllithium or sodium naphthalene, white, solid polymers into which approximately two mole per cent of the phosphonate monomer has been incorporated.

Diphenylvinylphosphine, a new compound, has been synthesized and its polymerization reactions studied. Homopolymerization of this monomer, the first such homopolymerization of a vinyl phosphine derivative, was accomplished using boron trifluoride and Ziegler-type catalysis; oils of low to intermediate molecular weight were obtained.

Copolymers of diphenylvinylphosphine were obtained with styrene using free radical initiation, and with ethylene, 1,3-butadiene, 1-decene, and 1,5-cyclooctadiene using Ziegler-type catalysis. Only the ethylene and 1,5-cyclooctadiene copolymers were solids, and all were of low molecular weight. The 1-decene copolymers were the only copolymers into which diphenylvinylphosphine was incorporated to a greater extent than the other comonomer; in most cases the incorporation of the phosphine monomer did not exceed one mole per cent. All the copolymers were of low molecular weight. These copolymerizations represent the first examples of copolymerization of vinyl phosphine derivatives.

Microfilm $2.75; Xerox $7.20. 152 pages.

PREPARATION OF SOME FLUORANTHENE DERIVATIVES, PART II: 2-AMINO- AND 2-N,N-DIALKYLAMINOMETHYL-1,2,3,10b-TETRAHYDROFLUORANTHEN-3-ONES.

(L. C. Card No. Mic 61-1933)

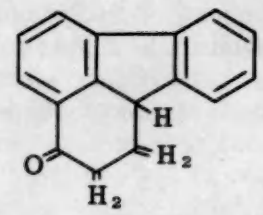
Ingo Hans Petersen, Ph.D.
State University of Iowa, 1961

Chairman: Professor Stanley Wawzonek

The purpose of this investigation was to prepare 2-amino- and 2-dialkylaminomethyl-1,2,3,10b-tetrahydrofluoranthen-3-ones for testing as analgesic and reserpine-like agents. Actual physiological evaluation of the prepared compounds was not a part of the study described herein.

1,2,3,10b-Tetrahydrofluoranthen-3-one (I) was the starting compound from which all of the aminoketones were prepared. To prepare the ketone, ethyl fluorene-9-carboxylate was reacted with acrylonitrile and the reaction product was hydrolyzed to produce β-9-fluorenylpropionic acid. The fluorenylpropionic acid was converted to the acid chloride, which was cyclized under Friedel-Craft conditions to obtain the desired tetrahydrofluoranthenone.

An effort to prepare β-9-fluorenylpropionic acid by reaction of 9-fluorenylpotassium with β-bromopropionitrile resulted in formation of fluorene and a material which, upon hydrolysis, gave a compound whose melting point corresponded with that reported for bis-9,9-(β-



I

carboxyethyl)-fluorene. An alternative preparation of 1,2,3,10b-tetrahydrofluoranthen-3-one by decarboxylation of 1-carboxy-1,2,3,10b-tetrahydrofluoranthen-3-one was also unsuccessful.

Mannich reactions of 1,2,3,10b-tetrahydrofluoranthen-3-one, secondary amine hydrochlorides and formaldehyde were used to prepare the hydrochloride salts of the following compounds: 2-N,N-dimethylaminomethyl-, 2-N,N-diethylaminomethyl-, 2-piperidinomethyl-, and 2-morpholinomethyl-1,2,3,10b-tetrahydrofluoranthen-3-one. The Mannich bases underwent thermal decomposition to form the starting amine salt and a high-melting compound which was probably a dimer of 2-methylene-1,2,3,10b-tetrahydrofluoranthen-3-one. Except for the morpholino compound, the reaction products were also unstable to bases.

2-Amino-1,2,3,10b-tetrahydrofluoranthene hydrochloride was prepared by catalytic reduction of 2-oximino-1,2,3,10b-tetrahydrofluoranthen-3-one in an acid medium. The oximinoketone was prepared by the action of butyl nitrite on 1,2,3,10b-tetrahydrofluoranthen-3-one. To confirm that the reaction had not formed 2-nitroso-3-fluoranthenol, an authentic sample of the latter compound was prepared by nitrosation of 3-fluoranthenol. Comparison of the products of the two reactions showed them to be different compounds.

Microfilm $2.75; Xerox $6.20. 128 pages.

THE STRUCTURE AND ORIGIN OF TWO LOW MOLECULAR WEIGHT LIGNIN SULFONATES

(L. C. Card No. Mic 61-1331)

Siegfied Wolfram Schubert, Ph.D.
University of Washington, 1960

Chairman: Joseph L. McCarthy

This research has been concerned with the synthesis and structure determination of two low molecular weight lignin sulfonates isolated from spent sulfite liquor, the mechanism of their formation and investigation of their origin.

Studies on the synthesis of Lignin model compounds showed that the sulfonation of isoeugenol under certain conditions yields two sulfonates not encountered previously. Available analytical data are still insufficient to allow assignment of structures. One of these compounds was observed to cleave its methoxyl group during sulfonation. This has never been observed previously.

Studies on the mechanism of the Mannich Synthesis show that attack of the reagents proceed in a normal fashion, i.e. adjacent to the carbonyl group and not at the ortho position to the hydroxyl group of the aromatic nucleus as was reported recently in the literature.

The sulfonation of coniferyl benzoate was recognized as the most suitable synthesis of the two desired lignin sulfonates and their structure was determined as that of calcium 1-(3-methoxy-4-hydroxyphenyl)-2-propene-1-sulfonate ("MA-1") and calcium 1-(3-methoxy-4-hydroxyphenyl)-1-propene-3-sulfonate ("MB-1").

Studies on the mechanism of the sulfonation of coniferyl benzoate show that the reaction is catalyzed by hydrogen ions to form a mesomeric allylic carbonium ion which upon attack of the nucleophilic bisulfite ion yields the two desired sulfonates as main products in satisfactory yields.

The lignin-like structure of both sulfonates was observed by their ready oxidation to vanillin in alkaline solutions in the presence of nitrobenzene. Yields of vanillin were 75% of the theoretical for both compounds.

Lignin was prepared from preextracted wood by a recently reported method and subsequently sulfonated. Upon work-up of the reaction products a low molecular weight lignin sulfonate was isolated and shown to be identical with one of the sulfonates (MA-1) obtained from spent sulfite liquor and the synthesis from coniferyl benzoate. There is also evidence for the occurrence of the other lignin sulfonate (MB-1) in the reaction products.

The relationship of the low molecular weight lignin sulfonates with the structure of lignin is discussed in view of the isolation of these compounds from lignin and the mechanism of their formation.

Microfilm $2.75; Xerox $6.80. 142 pages.

COMPETITIVE MEERWEIN REACTIONS: I — A METHOD OF DETERMINING ARYL RADICAL AFFINITIES.

(L. C. Card No. Mic 60-5294)

Martin Milton Skoultchi, Ph.D.
New York University, 1960

Adviser: S. C. Dickerman

Previous workers have presented evidence that the mechanism of the Meerwein reaction involved the addition of an aryl radical to a monomer. Thus, competitive Meerwein reactions might provide a method of measuring relative aryl radical affinities of olefins.

Competitive Meerwein reactions were carried out under nitrogen in an aqueous acetone solution of the reactants at 25°C. Acrylonitrile and methacrylonitrile were selected as two reference monomers. In a typical experiment, 0.8 mole of both acrylonitrile and the monomer to be compared were allowed to compete for the aryl radicals generated by the cuprous chloride catalyzed decomposition of 0.04 mole of the diazonium salt. The mixture of Meerwein products was analyzed by a determination of the amount of aliphatic-bound halogen, and by a quantitative hydrolysis of the nitrile group to ammonia. The difference between the halogen and nitrile analyses afforded an estimation of the amount of product corresponding to the other competitive olefin. The analytical method was tested by the analysis of a known mixture of two Meerwein products. The system, methyl acrylate-acrylonitrile was studied with the purpose of ascertaining whether the assumptions inherent in the kinetic derivation were valid. The measured relative reactivities were insensitive to changes in concentration of both cuprous and cupric chlorides.

The rate constants for the addition of phenyl radical to methyl acrylate, styrene, and methyl methacrylate relative to both acrylonitrile and methacrylonitrile, and p-chlorophenyl affinities of the same monomers relative to acrylonitrile, have been measured. In addition, the m-bromophenyl and p-bromophenyl affinities of methyl methacrylate relative to acrylonitrile were determined.

The data obtained in this way was unique, reproducible, internally consistent, and qualitatively in agreement with previous estimates of the radical affinities (other than aryl) of these monomers. It is concluded that competitive Meerwein reactions may be used to measure relative aryl radical affinities of monomers, and thus to determine substituent effects in both radical and monomer.

Microfilm $2.75; Xerox $4.00. 72 pages.

N-GUANYLARSANILIC ACID AND CERTAIN OF ITS DERIVATIVES

(L. C. Card No. Mic 61-1417)

William Carl Stickler, Ph.D.
Columbia University, 1961

Of the many thousands of organic compounds containing arsenic, only a very few have clinical value, e.g., arsphenamine, mapharsen, tryparsamide, acetarsone, and carbarsone. This illuminates the fact that chemotherapy is largely an empirical science and the search for new arsenicals continues. The field has received new attention during recent years when global warfare posed new health problems.

The work described in this Dissertation was undertaken in the hope of finding an organic arsenic compound effective in the treatment of trypanosomiasis and similar protozoic diseases such as spirochetosis and amoebiasis.

Specifically, N-guanylarsanilic acid was chosen for study in the hope that by retaining the skeletal structure of atoxyl, but replacing the amino group by the guanidino group, a compound may be obtained with a favorable chemotherapeutic index for the treatment of trypanosomiasis and yet free of the dangerous toxic propensities of arsenicals.

The desired compound has been obtained as the monohydrate by reaction of arsanilic acid with cyanamide and also with S-methylthiourea sulfate (Rathke method). A hydrochloride, sulfate, nitrate and picrate of N-guanylarsanilic acid has been prepared. Two reduction products of the acid have been obtained; they are not well defined, but show properties of the arsenobenzene and of the dichloroarsine derivative, respectively.

A reliable method for the determination of arsenic in organic nitrogen compounds has been described (cf., W. C. Stickler, Anal. Chem., 24, 1219 [1952]).

The results of the tests by the Merck Institute for Medical Research for the efficacy of N-guanylarsanilic acid in vivo and in vitro are presented in this Dissertation.

A preliminary account of this work has appeared in SCIENCE, 100, 526 (1944).

Microfilm $2.75; Xerox $3.00. 43 pages.

THE CONVERSION OF ALKYL BENZYL KETONES INTO HETEROCYCLIC NITROGEN COMPOUNDS

(L. C. Card No. Mic 61-1390)

Eldon Harold Sund, Ph.D.
The University of Texas, 1960

Supervisor: Dr. H. R. Henze

A series of ten alkyl benzyl ketones were prepared by the interaction of phenylacetyl chloride and the proper dialkylcadmium. Two of these ketones, 1-phenyl-2-heptanone and 1-phenyl-2-octanone, were previously unreported. A semicarbazone and a hydantoin derivative of each ketone was prepared. Eight of the hydantoins prepared had not previously been reported.

Subsequently the alkyl benzyl ketones were condensed under Pfitzinger conditions with isatin to form a series of 2-alkyl-3-phenylcinchoninic acids. Of the ten cinchoninic acids produced, seven were new, they being 3-phenyl-2-propylcinchoninic acid, 2-butyl-3-phenylcinchoninic acid, 2-isobutyl-3-phenylcinchoninic acid, 2-sec-butyl-3-phenylcinchoninic acid, 2-pentyl-3-phenylcinchoninic acid, 2-isopentyl-3-phenylcinchoninic acid and 2-hexyl-3-phenylcinchoninic acid.

These 2-alkyl-3-phenylcinchoninic acids were decarboxylated to the respective 2-alkyl-3-phenylquinolines, from which the picrate derivatives were prepared. By cyclization the 2-alkyl-3-phenylcinchoninic acids were converted into the corresponding 6-alkyl-11-indeno[1,2-c]-quinolin-11-ones, from which the oxime derivatives were prepared. Microfilm $2.75; Xerox $4.60. 87 pages.

STUDIES IN THE CHEMISTRY OF 1,5-DIARYL-2,3-PYRROLIDINEDIONES AND RELATED COMPOUNDS.

(L. C. Card No. Mic 60-6943)

Robert Coral Tripp, Ph.D.
University of Michigan, 1959

1,5-Diphenyl-2,3-pyrrolidinedione and its phenylamino derivative have both been reported to afford 1,5-diphenyl-3-arylimino-2-pyrrolidinones on reaction with various aromatic amines. o-Phenylenediamine has been reported to afford 4-phenyl-1,3-dihydro-1,5-benzodiazepine-2-one on reaction either with benzylidenepyruvic acid or with 1,5-diphenyl-2,3-pyrrolidinedione. Since the compound presumed to have the latter structure has been shown to be 3-phenylamino-5-phenyl-2(5H)-furanone rather than a pyrrolidinedione, the structures of its reactions products with amines required reinvestigation.

The reaction of 3-phenylamino-5-phenyl-2(5H)-furanone with aromatic amines was shown to involve initially an exchange of the 3-phenylamino group for an arylamino group to give a 3-arylamino-5-phenyl-2(5H)-furanone, followed by replacement of the heterocyclic oxygen atom by a second arylamino group under more vigorous conditions to give a 1-aryl-3-arylamino-5-phenyl-2(5H)-pyrrolone.

The product of the reaction of o-phenylenediamine either with 3-phenylamino-5-phenyl-2(5H)-furanone or with benzylidenepyruvic acid was found to be 2-phenyl-2,3-dihydrofuro[2.3-b]quinoxaline, rather than the benzodiazepine derivative previously reported. An analogous reaction occurs with p-anisylidenepyruvic acid.

1,5-Diphenyl-2-phenylamino-2(5H)-pyrrolone was found to react with aromatic amines by a similar process of exchange to give 1,5-diphenyl-3-arylamino-2(5H)-pyrrolones, essentially as previously reported. The latter structure was confirmed (for the 3-p-tolylamino derivative) by reaction of p-toluidine with authentic 1,5-diphenyl-2,3-pyrrolidinedione.

Another route to such compounds was developed by decomposing 1,5-diphenyl-3-hydroxy-4-carbethoxy-2(5H)-pyrrolone in the presence of amines. This reaction presumably proceeds via hydrolysis and decarboxylation to 1,5-diphenyl-2,3-pyrrolidinedione.

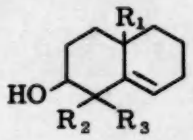
It was also found possible to effect ammonolysis of the ester function of 1,5-diphenyl-3-hydroxy-4-carbethoxy-2(5H)-pyrrolone by a high temperature reaction with amines to give N-substituted-4-carboxamides. The ease with which this reaction takes place in non-polar media is significant in view of the more drastic conditions required for hydrolysis.

Microfilm $2.75; Xerox $7.20. 152 pages.

AN INVESTIGATION OF ANCHIMERIC ASSISTANCE IN CERTAIN HOMOALLYLIC ALCOHOLS

(L. C. Card No. Mic 60-5067)

William John Adrian Vanden Heuvel, III, Ph.D.
Princeton University, 1960

A number of homoallylic alcohols, which may be represented by the formula  have been prepared,

and their p-toluenesulfonate esters solvolyzed in aqueous dioxane. Rate studies indicated that in all cases the double bond participated in the ionization of the ester, as reflected in an enhanced rate as compared with the rates of cholestanyl tosylate and several decalyl tosylates which were also prepared. The importance of the bridgehead group R_1 for participation of the double bond is greatest when R_2=R_3=H; when R_2=R_3=Me the rates are similar whether R_1=H or R_1=Me. The rate for the compound R_1=Me, R_2=R_3=H is comparable to that of cholesteryl tosylate; the geminally dimethylated esters possess rates comparable to 4,4-dimethylcholesteryl tosylate.

The rates of solvolysis of four steroidal tosylates have been determined. 4,4-Dimethylcholesteryl tosylate was found to possess a rate four times greater than that of cholesteryl tosylate, whereas 4,4-dimethylcholestanyl tosylate was found to solvolyze at a rate only one-third greater than that of cholestanyl tosylate, and only 0.005 that of the dimethyl unsaturated ester. These results are taken to indicate that 4,4-dimethylcholesteryl tosylate ionizes under solvolytic conditions with anchimeric assistance of the C_5-C_6 double bond rather than via C_4 - C_5 single bond participation.

4-Methylcholesterol has been prepared from cholesterol

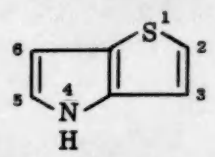
by Oppenauer oxidation to cholestenone, monomethylation of this compound to 4-methylcholestenone, and formation of the desired alcohol by enol acetylation, followed by sodium borohydride reduction, of the 4-methyl ketone. Tosylation with p-toluenesulfonyl chloride gave 4-methylcholesteryl tosylate which was subjected to solvolysis conditions. Microfilm $2.75; Xerox $4.80. 93 pages.

UTILIZATION OF 2H,3H-THIENO(3,2-b)PYRROL-3-ONE IN THE SYNTHESIS OF THIENO(3,2-b)PYRROLE DERIVATIVES.

(L. C. Card No. Mic 61-1681)

John Witt, Jr., Ph.D.
University of Illinois, 1961

Several derivatives of thieno(3,2-b)pyrrole (I) were prepared. 2H,3H-Thieno(3,2-b)pyrrol-3-one was used as the starting material in these syntheses.



I

Mannich reactions on 2-benzylidene-2H,3H-thieno-(3,2-b)pyrrol-3-one resulted in the formation of 6-dimethylaminomethyl-2-benzylidene-2H,3H-thieno(3,2-b)-pyrrol-3-one and 6-piperidinomethyl-2-benzylidene-2H,3H-thieno(3,2-b)pyrrol-3-one. A reaction of the Mannich base prepared from dimethylamine with refluxing acetic anhydride resulted in the formation of 4-acetyl-6-acetoxymethyl-2-benzylidene-2H,3H-thieno(3,2-b)-pyrrol-3-one. This compound was hydrolyzed readily in the presence of acid to 6-acetoxymethyl-2-benzylidene-2H,3H-thieno(3,2-b)pyrrol-3-one. The nuclear magnetic resonance spectra of these compounds show that the acetoxymethyl group is in the β-position of the pyrrole ring. Therefore, the structure of the Mannich base is also elucidated.

Bromination of 2-benzylidene-2H,3H-thieno(3,2-b)-pyrrol-3-one led to the formation of 6-bromo-2-benzylidene-2H,3H-thieno(3,2-b)pyrrol-3-one. The bromo derivative was converted to 4-acetyl-6-bromo-2-benzylidene-2H,3H-thieno(3,2-b)pyrrol-3-one by treatment with refluxing acetic anhydride. Proof of the structure of the bromo compounds is obtained from their ultraviolet and nuclear magnetic resonance spectra.

The reaction of dimethylamine, formaldehyde and 2-carbethoxy-3-tosyloxythieno(3,2-b)pyrrole resulted in the formation of 2-carbethoxy-3-tosyloxy-6-dimethylaminomethylthieno(3,2-b)pyrrole. The Mannich base reacted with refluxing acetic anhydride to form 2-carbethoxy-3-tosyloxy-4-acetyl-6-acetoxymethylthieno(3,2-b)-pyrrole. Evidence that the acetoxymethyl group is in the β-position of the pyrrole ring is obtained by means of nuclear magnetic resonance spectroscopy. The structure of the Mannich base is also determined.

The methosulfate of the Mannich base reacted with diethyl acetaminomalonate in the presence of sodium methoxide to form 2-carbethoxy-3-tosyloxy-6-[(β,β-di-carbethoxy-β-acetamino)ethyl]thieno(3,2-b)pyrrole. The tosyl group of this alkylated product was hydrolyzed by sodium hydroxide, yielding 2-carbethoxy-3-hydroxy-6-[(β,β-dicarbethoxy-β-acetamino)ethyl]thieno(3,2-b)pyrrole which exists as a monomer. Its monomeric structure is in contrast to other 2-carbethoxy-3-hydroxythieno(3,2-b)-pyrrole derivatives which exist as dimers.

Decarbethoxylation of 2-carbethoxy-3-hydroxy-6-[(β,β-dicarbethoxy-β-acetamino)ethyl]thieno(3,2-b)pyrrole was effected by dilute acetic acid and resulted in the formation of 6-(β,β-dicarbethoxy-β-acetamino)ethyl-2H,3H-thieno(3,2-b)pyrrol-3-one.

2-Carbethoxy-3-tosyloxy-6-formylthieno(3,2-b)pyrrole was prepared by a reaction of phosphorus oxychloride and dimethylformamide with 2-carbethoxy-3-tosyloxythieno-(3,2-b)pyrrole. The fact that the formyl group is in the 6-position is shown by a consideration of the nuclear magnetic resonance spectrum of the formyl derivative.

2-Isopropoxymethylene-2H,3H-thieno(3,2-b)pyrrol-3-one was prepared by a reaction of 3-hydroxythieno-(3,2-b)pyrrole-2-carboxaldehyde and isopropyl alcohol.
Microfilm $2.75; Xerox $4.00. 72 pages.

CINCHONINIC ACIDS DERIVED FROM ALKYL ETHYL KETONES THROUGH THE PFITZINGER REACTION

(L. C. Card No. Mic 61-1391)

James Bryan Zachry, Ph.D.
The University of Texas, 1960

Supervisor: H. R. Henze

A study of the Pfitzinger reaction was carried out by investigation of the condensation products of isatin and the homologous series of alkyl ethyl ketones. The unsymmetrical ketones, 2-butanone through 3-tridecanone, possess two methylene groups alpha to the carbonyl which conceivably could participate in the condensation to lead to the formation of two isomeric 2,3-dialkylcinchoninic acids. However, both isomers were isolated only from the reaction product involving the first member of the ketone series, 2-butanone. Structures of the isomers isolated were established, either by the independent syntheses of the same cinchoninic acids by the Doebner reaction, or by analogy to those reaction products whose structures were positively identified. The bulk of the reaction product was, in every instance, a 2-alkyl-3-methylcinchoninic acid (alkyl = methyl through decyl). Condensation, therefore, preferentially occurred with the methylene group of the ethyl portion of the alkyl ethyl ketone, which indicates that the methylene group of the ethyl portion has a greater activity than the α-methylene of the alkyl portion in Pfitzinger reactions.

Through decarboxylation of the 2-alkyl-3-methylcinchoninic acids, an homologous series of 2-alkyl-3-methylquinolines (alkyl = ethyl through decyl) was prepared and characterized; the 2-alkyl-3-methylquinolines from 2-butyl-3-methyl through 2-decyl-3-methyl had not previously been reported. The synthesis of 3-methyl-2-propylquinoline, through the preparation of the 4-chloro-3-methyl-2-propylquinoline and subsequent reduction by

a zinc dust distillation, had been claimed by Wöhnlich; however, the properties of the final product thus produced differed considerably from those of the quinoline obtained by the decarboxylation of 3-methyl-2-propylcinchoninic acid. A comparison of the two preparatory procedures indicates that Wöhnlich did not provide sufficient evidence to substantiate his claim; whereas, analytical data obtained in the present study for the quinoline product and its picrate and chloroplatinate derivatives leave little doubt that the decarboxylation product of the cinchoninic acid was the expected 3-methyl-2-propylquinoline.

Most of the alkyl ethyl ketones utilized in the Pfitzinger condensations were prepared in the laboratory. Few characterizing properties had previously been reported for several of the ketones; to aid in characterization, the homologous series of 5-alkyl-5-ethylhydantoin derivatives (alkyl = methyl through decyl) was completed.

Microfilm $2.75; Xerox $5.20. 105 pages.

CHEMISTRY, PHARMACEUTICAL

POLAROGRAPHIC STUDY OF IODOTHIOPHENES

(L. C. Card No. Mic 61-2093)

Leo Wayne Brown, Ph.D.
University of Washington, 1961

Chairman: Edward Krupski

A polarographic study of eight iodothiophenes was undertaken to provide additional information relative to the characteristics of the thiophene nucleus and to contribute to the knowledge of the reactions taking place at the dropping mercury electrode.

Polarograms for eight known iodothiophenes, 2-iodothiophene, 2,3-diiodothiophene, 2,3,4-triiodothiophene, 2,3,4,5-tetraiodothiophene, 2,3,5-triiodothiophene, 2,5-diiodothiophene, 3-iodothiophene, and 3,4-diiodothiophene, were obtained in the two solvents, N,N-dimethylformamide and 2-ethoxyethanol, and the half wave potential for each wave was determined. The polarograms of the compounds in both solvents were discussed, the waves contrasted and reasons postulated for their dissimilarities when differences occurred.

The reduction of the iodothiophenes at the dropping mercury electrode was found to be essentially the same as reduction of the iodothiophenes by chemical methods.

Reaction mixtures obtained in the preparation of some iodothiophenes were polarographed in order to determine their composition. The information gained from these polarograms was of value in determining the length of time that the reactions should be run under the conditions used.

A study of the wave heights versus concentration of 2-iodothiophene in N,N-dimethylformamide and in 2-ethoxyethanol was conducted and the diffusion current was shown to be proportional to the concentration; consequently a quantitative estimation of this compound could be made.

Single unknowns of iodothiophenes were polarographed and shown to be identifiable. Unknown mixtures of iodothiophenes with iodine substituted in positions that were not removed in the predetermined sequence were polarographed and shown to be identifiable only in some cases.

Microfilm $2.75; Xerox $4.60. 88 pages.

DERIVATIVES OF 7-METHYL-6-THIA-1,6-DIHYDRO- AND 7-METHYL-6-THIA-1,2,3,6-TETRAHYDROPURINE-6,6-DIOXIDE.

(L. C. Card No. Mic 61-1759)

Cheuk-Man Lee, Ph.D.
University of Michigan, 1961

The objective of this investigation was the preparation of the derivatives of 7-methyl-6-thia-1,6-dihydro- and 7-methyl-6-thia-1,2,3,6-tetrahydropurine-6,6-dioxide.

1-Methyl-4-nitro-5-chloroimidazole (I) was converted into 1-methyl-4-nitro-5-mercaptoimidazole (II) by reaction with sodium hydrosulfide. 1-Methyl-4-nitro-5-(chlorosulfonyl)imidazole (IV) was obtained by low temperature oxidative chlorination of II in dilute hydrochloric acid.

Compound II was reacted with ethyl chloroformate, bromoacetic acid or ethyl bromoacetate to yield the 5-carbethoxythio, 5-carboxymethylthio and 5-carbethoxymethylthio derivatives. Compound II was converted into the disulfide by the use of hydrogen peroxide and II was reduced to the corresponding amino compound by sodium hydrosulfite.

Compound IV was treated with phenol, 4-chlorophenol or 1-naphthol in pyridine to yield the 5-phenoxysulfonyl, 5-(4-chlorophenoxy)sulfonyl and 5-(1-naphthoxy)sulfonyl compounds.

A number of 1-methyl-4-nitro-5-sulfamylimidazoles were obtained by interaction of IV with ammonia, methylamine, dimethylamine, aniline, 2-methylaniline, 2-methoxyaniline, 2-chloroaniline and 1-naphthylamine. These nitro compounds were reduced to the corresponding amino compounds with hydrogen and Raney nickel. The formyl, acetyl and diacetyl derivatives of some of the amino compounds were prepared.

1-Methyl-4-nitro-5-sulfamylimidazole (VI) was reacted with a mixture of N,N-dimethylformamide and phosphorous oxychloride, and also with potassium cyanate, acetyl chloride and benzoyl chloride. Mannich reactions were carried out between VI, formaldehyde and morpholine or piperidine.

Reaction between 1-methyl-4-amino-5-sulfamylimidazole (VII) and butyric anhydride yielded the 4-butyrylamino derivative. Treatment of VII with ethyl chloroformate and pyridine produced 1-methyl-4-(carbethoxyamino)-5-sulfamylimidazole. By the use of the hydrochloride of VII and potassium cyanate, the 4-carbamylamino compound was obtained. These 4-substituted-amino compounds and the formyl and acetyl derivatives of VII could not be converted into the desired cyclic products by the action of heat, dilute sulfuric acid or aqueous sodium hydroxide.

Unsuccessful attempts were made to condense VII with urea, ethyl chloroformate, diethyl carbonate, formamide and acetic anhydride to yield the cyclic products.

Treatment of VII with formic acid, ethyl orthoformate, ethyl orthoacetate and ethyl orthopropionate, respectively, yielded 7-methyl-6-thia-1,6-dihydropurine-6,6-dioxide (VIIIa) and derivatives.

Compound VII was converted by phosgene and by thiophosgene into 7-methyl-6-thia-2-keto- (IXa) and 7-methyl-6-thia-2-thioketo-1,2,3,6-tetrahydropurine-6,6-dioxide (IXb), respectively. When IXa was allowed to react with dimethyl sulfate, a mixture of 1,3,7-trimethyl- (X) and 3,7-dimethyl-6-thia-2-keto-1,2,3,6-tetrahydropurine-6,6-dioxide (XI) was obtained.

1-Methyl-4-amino-5-(methylsulfamyl)imidazole (XII), when treated with phosgene and with thiophosgene, yielded 1,7-dimethyl-6-thia-2-keto- (XIIIa) and 1,7-dimethyl-6-thia-2-thioketo-1,2,3,6-tetrahydropurine-6,6-dioxide (XIIIb), respectively.

Attempts to obtain 7-methyl-6-thia-1,2,3,6-tetrahydropurine-6,6-dioxide by condensation of VII with formaldehyde under neutral, alkaline or acidic conditions or by reduction of VIIIa with hydrogen and Raney nickel or sodium borohydride were unsuccessful.

Microfilm $2.75; Xerox $4.60. 89 pages.

A PHYSICAL STUDY OF ADSORPTION PHENOMENA OF SOME PHENOTHIAZINE DERIVATIVES

(L. C. Card No. Mic 61-1334)

Donald Lloyd Sorby, Ph.D.
University of Washington, 1960

Chairman: Elmer M. Plein

This research represents a comprehensive study of practical and theoretical aspects of adsorption of phenothiazine derivatives by some pharmaceutic aids and therapeutic adsorbents. Effects of various parameters modifying or related to the adsorption process were also investigated.

Extents of adsorption of hydrochloride salts of fifteen phenothiazine derivatives from distilled water at 20° C. on kaolin, talc, and activated carbon (Norit A) were determined. Compounds not commercially available as hydrochloride salts were converted to this form by using an anion-exchange resin and the absence of undesirable anion in the sample was proved by paper chromatography. With exception of adsorption of dibasic compounds on talc, the data gave linear plots according to the Langmuir equation. The Langmuir constant, k_2, the reciprocal of the slope of a regression line calculated from the experimental data, was used to measure the extent of adsorption at saturation of the adsorbent surface.

The effect of controlled pH was studied using 0.03 M phosphate buffer systems at pH 2.5 and pH 6.5. The extent of adsorption was greater at pH 6.5 than at pH 2.5. Competitive adsorption between the pH 2.5 buffer and the phenothiazine derivative did not occur even though both buffer and compound were adsorbed.

Elevated temperature, 37° C., was found to increase the extent of adsorption of the two phenothiazine derivatives studied. No exact reason for this temperature effect is given although several possible reasons are discussed.

A possible relationship between the basicity of several phenothiazine derivatives and their extents of adsorption was investigated using the pKa', the negative logarithm of the dissociation constant of the tertiary amine cation-acid, as a measure of basicity of the compounds. Hydroalcoholic solutions of varying alcohol strength containing identical quantities of the phenothiazine derivative hydrochloride salt were titrated with standard base. The mean value for pKa' was calculated from the equation

$$pKa' = pH - \log \frac{C_{R_3N}}{C_{R_3NH^+}}$$

using several points on the titration curve at each alcoholic strength. The value of pKa' in water was found by calculating the zero alcohol concentration intercept of a regression equation for a plot of pKa' vs alcohol concentration. A method is proposed to allow one to utilize the above equation for pKa' in the range of alcohol concentration where the amine free-base precipitates during the titration.

Results indicated no direct relationship between basicity of the compounds and extent of adsorption.

A possible relationship between surface tension lowering of aqueous solutions by phenothiazine derivatives and their relative extents of adsorption was investigated. The amount of surface tension lowering for six compounds at 1×10^{-2} M concentration could not be related to the extent of adsorption on various adsorbents.

The rate of release of chlorpromazine hydrochloride into solution from each adsorbent was determined and in all cases there was a measurable rate of release. An elution study showed that chlorpromazine-Norit A adsorbate would release approximately 1/10 of the total adsorbed material whereas talc and kaolin seemed to release all adsorbed chlorpromazine.

Results of the research showed that no single factor seemed to control the adsorption process. It was postulated that the mechanism of adsorption is complex and involves several interrelated factors, none of which is dominant over the other.

Extents of adsorption compared to the usual therapeutic doses of these compounds were found to be significant in all cases. Possible use of the adsorbates as sustained release dosage forms and the significance of adsorption in altering availability of the drugs for intestinal absorption is discussed.

Microfilm $2.75; Xerox $8.60. 190 pages.

THE PREPARATION OF 2-KETOPOLYMETHYLENIMINES

(L. C. Card No. Mic 61-1797)

Raymond Eugene Stenseth, Ph.D.
University of Michigan, 1961

Two methods for the preparation of 2-ketopolymethylenimines were studied. These were (1) the conversion of basic nitriles by hydrogen chloride and heat into 2-iminopolymethylenimine hydrochlorides, followed by hydrolysis, and (2) the cyclization of basic amide hydrochlorides by pyrolysis. It was also found that Ivanov-like reagents could be obtained from a basic α-phenyl amide and a 3-phenyl-2-pyrrolidone.

Nine tertiary amino nitriles were synthesized and subjected to the action of hydrogen chloride and heat. Six of them yielded the expected 2-imino products. One of the six yielded, in addition, a 2-(alkylimino) compound. Only a 2-(alkylimino) product was obtained from one of the nitriles and two nitriles could not be converted into imino compounds.

The hydrochlorides of 1-methyl-2-iminopyrrolidine and 1-methyl-2-imino-3,3-diphenylpyrrolidine were hydrolyzed to the corresponding 2-pyrrolidones. 1-Butyl-2-imino-3-phenylpiperidine hydrochloride was hydrolyzed to α-phenyl-δ-butylaminovaleramide and to α-phenyl-δ-butylaminovaleric acid. The acid was converted by heat into 1-butyl-3-phenyl-2-piperidone. Crude 1-methyl-2-iminopiperidine hydrochloride was hydrolyzed to δ-methylaminovaleric acid. Treatment of the hydrochlorides of 1-methyl-2-iminopyrrolidine, 1-methyl-2-imino-3-phenylpiperidine and 1-butyl-2-imino-3-phenylpiperidine with nitrous acid yielded nitrates of the imino compounds instead of the expected 2-keto products.

1-Methyl-3-phenyl-2-pyrrolidone (I) was synthesized in 86% yield by pyrolysis of N,N-dimethyl-α-phenyl-γ-dimethylaminobutyramide (II) hydrochloride. The cyclization took place with the formation of trimethylamine.

Pyrolysis of the hydrochlorides of N,N-dimethyl-α-phenyl-α-ethyl-γ-dimethylaminobutyramide (III), N,N-dimethyl-α,α-diphenyl-γ-dimethylaminobutyramide and N,N-dimethyl-α-phenyl-δ-dimethylaminovaleramide yielded 1-methyl-3-phenyl-3-ethyl-2-pyrrolidone (IV) (93%), 1-methyl-3,3-diphenyl-2-pyrrolidone (88%) and 1-methyl-3-phenyl-2-piperidone (79%), respectively.

Pyrolysis of N,N-dimethyl-α-phenyl-α-(β-dimethylaminoethyl)-γ-dimethylaminobutyramide (V) dihydrochloride yielded a mixture of 1-methyl-3-phenyl-3-(2-dimethylaminoethyl)-2-pyrrolidone hydrochloride, isolated as the base (VI) (38%), and 1-methyl-3-phenyl-3-vinyl-2-pyrrolidone (VII) (36%). Compound VI was also obtained from I; VII was converted into IV. Compound IV, prepared from VII and also from III, was reduced to 1-methyl-3-phenyl-3-ethylpyrrolidine.

When III and V were prepared by reaction of II with sodamide and suitable alkylating agents, dimethyl-γ-phenylpropylamine (VIII) was isolated as a second product in both instances. An authentic sample of VIII was synthesized.

By the use of isopropylmagnesium chloride, I and II were converted into Ivanov-like reagents which reacted, for example, with formaldehyde to yield 1-methyl-3-phenyl-3-hydroxymethyl-2-pyrrolidone (IX) and N,N-dimethyl-α-phenyl-α-hydroxymethyl-γ-dimethylaminobutyramide (X), respectively.

Treatment of X with lithium aluminum hydride yielded β-phenyl-β-(dimethylaminomethyl)-δ-dimethylaminobutanol (XI). The dihydrochloride of XI was converted by heat into 1-methyl-3-phenyl-3-hydroxymethylpyrrolidine (XII). Reduction of IX with lithium aluminum hydride also produced XII.

After X had been treated with tosyl chloride and triethylamine, a crude quaternary salt was obtained which was converted by sodium iodide into 1-methyl-3-phenyl-3-(dimethylcarbamyl)pyrrolidine methiodide. Compound XI, tosyl chloride and pyridine yielded a pure quaternary tosylate hydrochloride; sodium iodide converted it into 1,1-dimethyl-3-phenyl-3-(dimethylaminomethyl)pyrrolidinium iodide hydriodide.

Microfilm $2.75; Xerox $8.60. 187 pages.

A STUDY OF THE IVANOV REACTION

(L. C. Card No. Mic 61-1815)

Paul Ernest Wright, Ph.D.
University of Michigan, 1960

The reagent [$C_6H_5CH(MgCl)COOMgCl$] obtained by interaction of phenylacetic acid with isopropylmagnesium chloride will be referred to as the Ivanov reagent.

The reaction between propylene oxide and the Ivanov reagent yielded α-phenyl-β-hydroxyvaleric acid (I) and two stereoisomeric lactones of α-phenyl-β-methyl-γ-hydroxybutyric acid; one lactone (II) was a liquid, the other (III) a solid. The structure of I was proven in the following manner: (a) by its synthesis from propionaldehyde and the Ivanov reagent; (b) by conversion of I to the methyl ester and successive dehydration, hydrogenation and hydrolysis of the ester with the formation of α-phenylvaleric acid. The structures of II and III were established by oxidation of the compounds with bromine, magnesium sulfate and sodium hydroxide with the formation of α-phenyl-α'-methylsuccinic acid.

Styrene oxide reacted with the Ivanov reagent to form a mixture of two stereoisomeric racemates of α,γ-diphenyl-β-hydroxybutyric acid (IV). The structures of these two products were proven by the fact that interaction of phenylacetaldehyde and the Ivanov reagent yielded the same two stereoisomers. Each acid was converted to the methyl ester by diazomethane, to the β-diethylaminoethyl ester with the aid of β-diethylaminoethyl chloride, to a diol by the use of lithium aluminum hydride and to a lactone by the use of methanol and sulfuric acid or acetic anhydride.

From the interaction of cyclohexene oxide and the Ivanov reagent a product, presumably α-phenyl-(2-hydroxycyclohexyl)acetic acid (V) was obtained. It was shown that this substance was not identical with another possible product, namely α-phenyl-β-cyclopentyl-β-hydroxypropionic acid (VI) which would have been formed if cyclohexene oxide had reacted in the form of cyclopentanecarboxaldehyde (VII). When VI was synthesized from VII and the Ivanov reagent, two stereoisomeric racemates were isolated both of which were different from V. A lactone was obtained from V.

It was found that the Ivanov reagent reacted with iodine to form meso-α,α'-diphenylsuccinic acid (VIII) in 55% yield, and that Ivanov-like reagents, prepared from N,N-dimethyl- and N,N-dibenzylphenylacetamide and isopropylmagnesium chloride, were converted by iodine to N,N,N',N'-tetramethyl- and N,N,N',N'-tetrabenzyl-α,α'-diphenylsuccindiamide, respectively.

When VIII was treated, successively, with isopropylmagnesium chloride and formaldehyde, two isomeric lactone-acids, lactones of α,α'-diphenyl-α-(hydroxymethyl)succinic acid and a dilactone of α,α'-diphenyl-di-α,α'-(hydroxymethyl)succinic acid were obtained.

It was shown that Ivanov-like reagents can be obtained from 1-benzyl- (IX) and from 1-hexahydrobenzyl-3-phenyl-2-azetidinone (X). Reagent IX reacted with acetone, phenyl β-dimethylaminoethyl ketone, benzophenone, cyclohexanone and carbon dioxide to form 3-substituted derivatives of IX. Interaction of reagent X with benzophenone yielded 1-hexahydrobenzyl-3-phenyl-3-(diphenylhydroxymethyl)-2-azetidinone the structure of which was proven by base-catalyzed cleavage into α-phenyl-β-hexahydrobenzylaminopropionic acid and benzophenone.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The sodium salt of α-toluenesulfonic acid was converted to an Ivanov-like reagent [$C_6H_5CH(MgCl)SO_3Na$] by the use of isopropylmagnesium chloride. This reagent reacted with formaldehyde, benzaldehyde, acetone, benzophenone, cyclohexanone and carbon dioxide to form sodium salts of α-substituted α-toluenesulfonic acids. The products were isolated as S-benzylthiuronium salts. The reaction product, obtained by the use of benzaldehyde, consisted of two stereoisomeric racemates of the sodium salt of α-(phenylhydroxymethyl)-α-toluenesulfonic acid which were isolated as S-benzylthiuronium salts.

Microfilm $2.75; Xerox $6.40. 132 pages.

CHEMISTRY, PHYSICAL

OBSERVATIONS ON THE MOLECULAR EFFUSION OF CESIUM CHLORIDE

(L. C. Card No. Mic 61-1589)

John Quincy Adams, Ph.D.
University of Illinois, 1961

The number of molecules which had effused through a circular canal into a high vacuum was measured as a function of the angle between the path of the molecules and the axis of the canal, and as a function of the vapor pressure behind the canal. The total number of molecules effusing per second and several empirical distribution functions were calculated from the distribution-in-angle data.

The experiment had a dual purpose: first, to check the theory of effusion of P. Clausing and W. C. DeMarcus which was thought to be valid for molecules effusing through right-cylinder canals at low vapor pressure; and second, to discover what distribution-in-angle law was valid at somewhat higher vapor pressures.

During an experiment the vapor of cesium chloride effused from a copper oven into the vacuum where it was detected by a surface ionization gauge. The rotation of the oven through an angle of 180° allowed the stationary surface ionization gauge to explore along an arc which encompassed the entire hemisphere in front of the orifice. Distribution-in-angle data were taken from three different orifices: two of them having the shape of a right cylinder and one having the shape of a truncated right cone. The cylindrical orifices were about 0.25 mm in diameter and had length/diameter ratios of 0.49 and 1.3. The conical orifice had an inside diameter of 0.32 mm at the gas entrance, a length of 9.2 mm, and a half-angle of 16°.

The measurements uncovered two unexpected phenomena. For all three orifices the distribution-in-angle of the effusing molecules was a fluctuating function of the vapor pressure behind the orifice. Furthermore, the transmission coefficient of each orifice was also a fluctuating function of the vapor pressure behind the orifice. The transmission coefficient was defined as N/Z; where N was the total number of molecules effusing from the orifice per second, as determined from the experiment; and Z was the total number of molecules entering the orifice from the oven chamber, as calculated from the kinetic theory of gases. The greatest fluctuation with vapor pressure did not occur in the same range of pressure for all three orifices. The fluctuations were most violent in the case of the conical orifice. In general the distribution functions of the right-cylinder orifices bore a family resemblance, in curve shape, to the distributions predicted by the Clausing theory; but the experimental results deviated from the Clausing theory by 12.5% at the lowest vapor pressure, where the mean free path of the gas molecules was 52 times the orifice diameter. And through the pressure range in which the Clausing theory might be valid, there were large deviations from the theory.

Microfilm $3.05; Xerox $10.60. 235 pages.

INFRARED REFLECTION STUDY IN MOLECULAR CRYSTALS

(L. C. Card No. Mic 61-1911)

George Robert Anderson, Ph.D.
State University of Iowa, 1961

Chairman: Assistant Professor Willis B. Person

A method is reported by which absolute intensity coefficients were computed from near normal (10°) incident reflection measurements in the infrared on solid benzene (at ~ - 160° C) and ammonium halide crystals. These solids had previously been studied by the direct absorption method and were chosen so that comparisons could be made. The index of refraction, n, and the absorption coefficient, κ, were calculated over the band from reflectance spectra by a method adapted from Robinson and Price.* The κ curve was then integrated to get the absolute intensity coefficient, Γ_i.

Some of the more important derivations and relationships of physical optics are outlined which are important in the study of reflection spectroscopy. Beginning with Maxwell's equations, the theory of light, dispersion, reflection, and thin films are treated. In addition, an approximation is reported by which the integral used to calculate the phase shift may be evaluated. With this approximation, the laborious computation procedure inherent in the Robinson and Price method was programmed for an electronic computer, and the optical parameters (n and κ) were computed "directly" from the reflection data.

A description is given of the experimental problems involved in making reliable reflection measurements. Modifications of the source optics of the spectrometer were necessary in order to make the 10° from normal reflection measurements. A cold cell was constructed to hold the solid benzene sample along with a special cell mount constructed to rigidly hold the cell. The entire experimental procedure is outlined including the preparation of the sample and the method in which the data was handled. The ammonium halide samples were salt pellets formed in an ordinary pellet press. Due to the relative simplicity of this method, recommendations for further applications of the "pellet reflection technique" are made.

For each fundamental study, the reflectance spectra are presented, the calculated optical parameters are given, and the absolute intensity coefficients are tabulated.

The intensity results for benzene are reported as follows: 687 cm^{-1} band $\Gamma(\nu_{11})$ = 13.5, 1036 cm^{-1} band $\Gamma(\nu_{20})$ = 1.57, and 1480 cm^{-1} band $\Gamma(\nu_{19})$ = 2.79 cm^2/millimole (Crawfords). For the ammonium ν_4 fundamental at 1400 cm^{-1}, $\Gamma(\nu_4)$ = 12.0 and 15.0 Crawfords for NH_4Cl and NH_4I respectively. The errors involved in these results are discussed and an estimate of the maximum uncertainty in Γ of 25 percent is reported.

In a comparison of the benzene results with the results from direct absorption measurements, a significant discrepancy was observed; the intensity values measured elsewhere by the absorption method were lower roughly by a factor of 2.5 over-all. The ammonium ion results, however, showed relatively good agreement between the intensity values measured by the two different methods.

There was concern that the absorption measurements were being complicated by the necessary existence of a thin film sample, and thus, a study was made on the theoretical transmission of a thin film of solid benzene. From the optical parameter data for the ν_{11} fundamental, the shape of the computed thin film absorption band was observed to be distorted compared to the shape of the true absorption band, but the measured area under the thin film absorption band was not found to be significantly different from that measured under the true absorption band. These results indicated that reasonable assurance can be placed in the absolute intensity values of solid benzene measured by the direct absorption method, and that at present there are insufficient examples of intensity results measured by either method to decide between the intensity values or to account for the difference. However, the good agreement found in the comparison of intensity results of the NH_4^+ ion is reported as evidence that the reflection method may indeed be a valid method of measuring infrared intensities in the solid phase.

*T. S. Robinson and W. C. Price, Molecular Spectroscopy (Institute of Petroleum, London, 1955) pp. 211-223.

Microfilm $2.75; Xerox $7.60. 165 pages.

ANODIC BEHAVIOR OF GOLD: I. SURFACE OXIDATION. II. MONOLAYER ADSORPTION OF PALMITIC ACID.

(L. C. Card No. Mic 61-1600)

Mou Shu Chao, Ph.D.
University of Illinois, 1961

The surface oxidation of a bright gold foil electrode in perchloric acid was studied by anodization at constant potential and cathodic chronopotentiometry. The cathodic charge, which was a measure of surface oxidation, was observed as a function of: (1) the length of anodization, (2) open circuit drift after anodization, (3) the potential of anodization, (4) a lower potential imposed after anodization, (5) pH, and (6) the cathodic current density.

The anodic reaction is explained as a mixed process of oxygen evolution and the formation of chemisorbed oxygen, which takes the configuration of auric oxide when thicker than a monolayer. When the electric current is stopped during anodization, the oxygen evolution ceases and the potential decays toward the oxide potential. The surface oxidation is highly irreversible, as shown by the hysteresis loop on a surface oxidation-potential plot. No evidence has been found for discrete lower oxides, Au_2O and AuO, as intermediates.

The grain boundary diffusion of oxygen atoms has been found satisfactory in accounting for the residual current during anodization and the increase of surface oxidation with time at constant potential. The effective grain boundary diffusion coefficient has been estimated as 10^{-17} $cm^2 sec^{-1}$, the same order of magnitude as that reported previously in the case of platinum.

The double layer capacity-potential curve can be roughly divided into two sections. In the potential region below the start of surface oxidation, the capacitance decreases with increasing potential; in the potential region of surface oxidation, the capacitance is relatively constant. The surface oxidation is considered to enhance the capacitance in a similar way as the case with many other metals including platinum, but its effect in the case of gold is masked by the large drop of capacitance with increasing potential in the absence of surface oxidation.

The cathodic charge is relatively constant over a thousand-fold range of current densities. The sole cathodic reaction is believed to be the formation of water. At very low current densities, the smaller charge observed suggests the occurrence of a competing path of reduction involving reaction intermediates formed during the primary reduction process. This hypothesis is supported qualitatively by the observation that an intermittent cathodization yields a smaller cathodic charge than a continuous one.

The Langmuir-Blodgett technique was used to deposit a monolayer of C^{14}-tagged palmitic acid on the electrode. The extent of surface coverage was determined by liquid scintillation counting. Complete coverage was obtained on both the reduced and the oxidized electrodes. That the monolayer could be easily removed from an oxidized electrode by extraction with a non-polar solvent meant the basicity of the oxide was very weak.

The desorption of a monolayer from the electrode under oxidizing and reducing potentials was followed by capacitance measurements and checked by scintillation counting. It was found that the desorption at a reducing potential was slower than at an oxidizing potential and the desorption was larger when there was an oxidation or reduction after the monolayer had been deposited.

Electron micrographs were made on replicas of gold which had undergone different treatments. More vigorous reaction probably had taken place at grain boundaries than on the smooth surfaces, as the boundary lines were evident only on the used electrodes, both oxidized and reduced, but not on cold rolled or fire polished gold.

Microfilm $2.75; Xerox $5.00. 99 pages.

THE ADSORPTION OF POLY-(METHYLMETHACRYLATE) FROM SOLUTION ON TO SOLID SURFACES

(L. C. Card No. Mic 61-1266)

Stuart M. Ellerstein, Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: Robert Ullman

The present study was undertaken to investigate the adsorption of poly-(methylmethacrylate) at the solid-liquid interface under a variety of experimental conditions. Some of the parameters considered in this work were the adsorbent, molecular weight of the polymer, shaking time, solvent power, structure of the polymer and temperature.

The adsorbents used in this work were iron and Pyrex glass powders. Since the adsorbents were thought to be nonporous, it was not too surprising to find that the amount of poly-(methylmethacrylate) specifically adsorbed at full coverage was effectively determined by the surface area of the adsorbent as determined by nitrogen adsorption (BET) measurements. The initial rise of the isotherms was extremely steep for both adsorbents, and thus could not be determined accurately with the infrared analytical technique used. Equilibrium was apparently established in a matter of minutes, which is the time necessary to insure thorough mixing of the adsorbent and the solution, although prolonged shaking caused possible fractionation or degradation.

Molecular weights of the polymers were determined by both viscosity and light scattering measurements. It was found that the amount adsorbed increased slowly with molecular weight in the range 10^4-10^6, although no adsorption was detected for a monomeric analog (methyl isobutyrate).

An attempt was made to correlate the adsorption with solvent power using both the intrinsic viscosity and cohesive energy density of the solvent as criteria. It was observed, as expected, that the amount adsorbed was greater from poor solvents than from good ones except where a specific interaction was suspected. This general trend was also noted in several mixed solvent systems. Some desorption experiments, wherein some of the supernatant solution was replaced by solvent after adsorption had equilibrated, revealed apparent irreversibility. Since this was not the case in a solvent where specific interactions between solvent and/or adsorbent took place, it was thought that the apparent irreversibility in the earlier case was a manifestation of nonequilibrium.

Similar results were obtained in temperature studies which revealed an apparent one-sidedness in the way that equilibrium was attained. Thus a sample that was brought to quasi-equilibrium at a high temperature would not revert to its equilibrium value when cooled and shaken at a lower temperature, although equilibrium was generally reached if the low temperature treatment preceded the high temperature treatment.

Structural changes in the chemical makeup of the poly-(methylmethacrylate) molecule were found to affect the adsorption in a marked way. Thus a small percentage of carboxyl groups substituted for methyl ester groups caused a threefold increase in the adsorption. Another interesting result was obtained by using an isotactic polymer instead of the usual atactic type. It was observed that the stereospecific polymers produced an isotherm with a positive slope in the region where the random polymer gives an essentially flat plateau.

Some simple models of polymer adsorption are presented and evidence is cited for each. The present state of statistical theory in regard to polymer adsorption is briefly discussed. The experimental data were fitted to the Langmuir isotherm.

Microfilm $2.75; Xerox $7.20. 154 pages.

STUDIES ON THE MECHANISM OF ELECTRODEPOSITION AND DISSOLUTION PROCESSES OF METALS IN AQUEOUS SOLUTIONS

(L. C. Card No. Mic 60-3648)

Mich. Enyo, Ph.D.
University of Pennsylvania, 1960

Supervisor: John O'Mara Bockris

Detailed considerations are given concerning the basic character and practical problems involved in the galvanostatic transient technique of polarization measurements.

In Part I, kinetic studies of the electrodeposition and dissolution reactions of copper in solutions of cupric sulfate, chloride, perchlorate, acetate and aminosulfonate with their corresponding acids were carried out by means of long-time and galvanostatic transient polarization methods at 30°C, using spherical polycrystal copper electrodes. These were prepared under a helium atmosphere, or by electrodeposition on those electrodes.

The long-time method gave essentially the same overpotential-current density relations as that obtained by the galvanostatic transient method on the electrodeposited electrodes, where the Tafel relations were observed with the slopes of about 120 and 40 mV respectively in the cathodic and anodic regions. The charge-transfer controlled mechanism proposed by Mattsson and Bockris (Trans. Faraday Soc., 55, 1586 (1959)) proved to be the case on those electrodes, with little anionic effect upon the values of reaction parameters. Overpotential-time transients on those electrodes indicated a considerable deviation in the rise-time from that expected from double layer charging, and this was interpreted semi-quantitatively in terms of the cuprous ion formation or consumption in the solution near the electrode surface during the transient, which was expected from the reaction mechanism adopted.

On the helium-prepared electrodes, the anodic Tafel lines were less clearly defined, and the cathodic ones were not observed in most cases. The cathodic overpotentials were smaller than those observed on the electrodeposited electrodes at high current densities, but they were much larger at low current densities. A different type of deviation of the overpotential-time transient was observed with those electrodes at low current densities; i.e., slower rise-time compared with those on the electrodeposited electrodes, and much higher values of the steady state overpotential. This was interpreted in terms of the surface diffusion process of adions (or adatoms) on the electrode.

Similar studies were also carried out on the effect of

different crystallographic faces of single crystals of copper upon the reaction mechanism. Serious difficulties were, however, encountered in obtaining the faces of the single crystals with well defined surface structures. On the crystal faces prepared by conventional techniques, the results were similar to those obtained on the polycrystal electrodes, but they were not accurate enough to distinguish among different faces.

In Part II, galvanostatic transient polarization studies on the electrodeposition reactions of gallium onto liquid and solid gallium electrodes were carried out in alkaline solutions containing gallic chloride, in order to examine the importance of the surface diffusion process of adions, which was considered in Part I.

With liquid gallium electrodes, clear cathodic Tafel lines were obtained, with the slope of about 130 mV. Excellent agreement was obtained between the experimental overpotentials and those calculated from a model involving a charge-transfer controlled mechanism, in the entire overpotential regions studied.

With solid gallium electrodes, the overpotentials were comparable with, but higher than those on liquid electrodes. The deviations in the overpotentials observed with the solid electrodes were interpreted in terms of rate controlling influence of the surface diffusion process of adions. Microfilm $5.75; Xerox $20.50. 451 pages.

REACTIONS OF THE ALUMINUM ION IN AQUEOUS SOLUTIONS AND CLAY SUSPENSIONS

(L. C. Card No. Mic 61-1427)

Charles Richard Frink, Ph.D.
Cornell University, 1960

A study was made of the hydrolysis of aluminum salt solutions, the solubility of gibbsite in synthetic solutions and soil extracts, and the exchange reactions of the aluminum ion in clay suspensions. Critical evaluation of analytical methods for the determination of aluminum showed that the "aluminon" method is adequate for routine analyses but is less accurate than the method involving chloroform extraction of the aluminum hydroxyquinolate complex. Methods of storing, filtering and centrifuging aluminum solutions and soil extracts were also carefully examined. The procedure adopted for obtaining clear soil extracts without loss of aluminum involved the use of high speed centrifugation.

The hydrolysis of purified solutions of $AlCl_3$ and $Al(ClO_4)_3$ was studied in order to establish the mechanism of hydrolysis of the aluminum ion. Comparison of various proposed hydrolysis mechanisms on the basis of the constancy of their calculated equilibrium constants demonstrated that the classical monomeric hydrolysis mechanism gave the most consistent agreement with the experimental data. Measurement of the limiting equivalent conductance of $AlCl_3$ by two virtually independent methods supported this choice of mechanism. The value for the limiting equivalent conductance of $AlCl_3$, which has not been previously reported, was found to be 136 at 25°C. The values for the hydrolysis constant based on the simple monomeric hydrolysis mechanism were in satisfactory agreement for both salts studied. The value for pK of 5.02 ± 0.03 at 25°C and zero ionic strength found for $AlCl_3$ is considered to be more reliable owing to a slight uncertainty in the determination of free acid in the $Al(ClO_4)_3$ stock solution.

Analysis of the data showed that, on dilution, aluminum solutions will become supersaturated with respect to gibbsite, the thermodynamically stable phase of $Al(OH)_3$. The solutions were, however, metastable with little tendency for precipitation. Precipitates were found in supersaturated solutions to which base had been added. The rate of dissolution of pure, crystalline gibbsite in undersaturated solutions was found to be very slow, but supersaturated solutions, when seeded with gibbsite, reached equilibrium rapidly. The solubility product of gibbsite, expressed as pK_{sp}, was found to be 33.51 at 25°C. The equilibration of gibbsite with 0.01M $CaCl_2$ soil extracts was also found to be a very slow process, indicating that extreme care should be exercised in the use of the solubility product principle for the purpose of establishing the existence of gibbsite in soils.

The hydrolysis and exchange reactions of the aluminum ion were studied in hectorite and montmorillonite clay suspensions. It was shown that the amount of exchangeable aluminum may be expressed either by assuming all of the aluminum to be trivalent, or by adding together Al^{+3} and equivalent amounts of the hydrolysis products $AlOH^{+2}$ and H^+. It was found, however, that most of the adsorbed aluminum is indeed trivalent owing to the suppression of hydrolysis of the aluminum ion in the presence of the high concentration of H^+ ions on the clay surface as predicted by the Boltzmann distribution law. It was also shown that, in the presence of the clay, the degree of hydrolysis of the aluminum ion in the bulk solution is suppressed as compared to the degree of hydrolysis of an aqueous reference solution of the same total aluminum concentration. The fixation of aluminum by clays in non-exchangeable form was not found to produce any substantial reduction in exchange capacity and must, therefore, be attributed to precipitation of $Al(OH)_3$. At high basicities there was some evidence for the fixation of both aluminum and magnesium ions with a concomitant decrease in the exchange capacity of the clay. The formation of a mixed aluminum and magnesium chlorite interlayer was suggested under such conditions.

Microfilm $2.75; Xerox $7.60. 161 pages.

DEPOLARIZED NICKEL DISSOLUTION IN AQUEOUS ACID SOLUTIONS

(L. C. Card No. Mic 61-1387)

Larry R. Harrington, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Norman Hackerman

The dissolution rates and corrosion potentials of cylindrical nickel specimens were measured for different speeds of rotation in hydrochloric acid solutions of ferric chloride and benzoquinone, and in sulfuric acid solutions of ferric sulfate. Dissolution rates less than about 0.1 mg min^{-1} cm^{-2} are controlled mainly by transport of

depolarizer to the metal surface, as indicated by: (1) a correlation of the difference between rate constants measured in ferric chloride and quinone with their estimated diffusion coefficients, (2) the general agreement between rate constants obtained with nickel in this work and constants reported by other workers for different metals in the same media, and (3) the demonstrated influence of rotational speed on dissolution rate, which is shown to be consistent with the predictions of hydrodynamic theory for mass transport.

Rate constants determined in connection with dissolution rates greater than about 0.1 mg min^{-1} cm^{-2} are somewhat less than predicted by a relation between rate constant and peripheral speed (established with lower dissolution rates in this work), especially in solutions having hydrochloric acid concentrations greater or less than 0.5 N. This disparity is less than 20 per cent in solutions 0.5 N in hydrochloric acid, and probably is related to a coating which formed on the surface under these conditions.

A linear relation between the corrosion potential and the logarithm of the dissolution rate describes all data in 0.5 N hydrochloric acid solutions containing ferric chloride. Considering the corrosion potential as determined by the intersection of partial anodic and cathodic polarization curves for the oxidation and reduction parts of the over-all reaction, this relation is presented as an approximate anodic polarization curve for nickel.

Microfilm $2.75; Xerox $4.20. 76 pages.

A STUDY OF HYDROGEN BONDING BY DIELECTRIC METHODS AND BY NUCLEAR MAGNETIC RESONANCE

(L. C. Card No. Mic 61-1285)

Charles Frederick Jumper, Ph.D.
The Florida State University, 1961

A property of the hydrogen bond that had previously been almost completely uninvestigated in the liquid state was its geometry, i.e., the relative orientations of the molecules forming the hydrogen bonded complex. This work was such an investigation.

An obvious method for studying the geometry of these complexes was to determine the dielectric constants of solutions of polar substances that interact to form such complexes. From these data it was possible to determine the dipole moment of the complex, and by knowing the dipole moments of the constituent molecules, we could infer the relative orientations of the constituent molecules. A complication to this interpretation that arose was that the dipole moment of the complex was not exactly the vector sum of the dipole moments of the constituent molecules because of the mutual dipole-induced dipole interactions of these molecules. The extent of this interaction cannot be calculated exactly, but our investigation indicated that it is probably of the order of 0.4 Debye unit for the systems studied.

To find a relationship between dielectric constant, dipole moment and concentration, we started with the equation of Onsager as modified by Böttcher and Scholte. We derived an equation of the form

$$\varepsilon = a + bM + cM^2$$

where M is the stoichiometric molarity of both the proton donor and acceptor, and a, b and c are functions of the dipole moments of the uncomplexed solute molecules and of the hydrogen bonded complex, as well as molecular constants such as polarizability, "shape factor," association constant, etc. Fitting our dielectric constant data to a quadratic in the concentration gave numerical values for the functions a, b and c, and from these we calculated the dipole moment of the complex.

Chloroform was used as the proton donor throughout, and the acceptor molecules were pyridine, acetonitrile, triethylamine, acetone, diethyl ether and isopropyl ether. The solvent was carbon tetrachloride, except for triethylamine where cyclohexane was used, and for diethyl ether where both carbon tetrachloride and cyclohexane were used.

In combination with the association constants determined by NMR, the dielectric results indicated that for pyridine, acetonitrile, triethylamine, diethyl ether and isopropyl ether the angle between the chloroform moment and the base moment is about zero degrees. For acetone this angle is about 60 degrees.

Nuclear Magnetic Resonance was used to measure the association constants between chloroform and the above mentioned base molecules. The chemical shift of the chloroform proton relative to a cyclohexane internal standard was measured by the sideband technique to a precision of ± 0.1 cps. at 40 Mc. This observed chemical shift was then corrected for three effects: 1) the difference in molar volume between cyclohexane and chloroform; 2) the self-association of chloroform; and 3) the apparent association of chloroform to carbon tetrachloride. This corrected chemical shift is a linear function of the fraction of the chloroform complexed to the base. By assuming various association constants we calculated the fraction of chloroform bonded, and for a series of solutions of varying concentrations we fit our data to straight lines by least squares, taking as the best association constant that one which gives the line with the smallest sum of the squares of the residuals. The slope of the best straight line can be shown to be the difference between the shifts of complexed and uncomplexed chloroform. For pyridine, acetonitrile and acetone, the relative magnitude of this shift difference can be explained qualitatively on the basis of the motions of π-electrons.

Microfilm $2.75; Xerox $6.60. 138 pages.

SPECTRAL MEASUREMENT OF MILLISECOND KINETIC PROCESSES WITH 0.1 CM^{-1} RESOLUTION

(L. C. Card No. Mic 60-6297)

Henry Hermann Kramer, Ph.D.
Indiana University, 1960

A method was developed in this investigation that combines the advantages of high resolution spectroscopy, electronic light detectors, and high intensity xenon arc

light and energy sources, and, thus, permits quantitative kinetic measurements of millisecond processes to be made on a single rotational line of a vibronic band of a molecule.

The apparatus that was constructed consists of the following parts:

1. A stigmatic grating spectrometer with a theoretical resolving power of 360,000 in the second order.
2. A dual beam optical system.
3. A multiple flash light source which will produce from a xenon lamp a train of four high intensity pulses that are separated by accurate time intervals which can be varied from 0.2 to 5.0 milliseconds with amplitudes reproducible to 5 to 10 per cent.
4. A flash photolysis source to initiate reactions with a maximum available energy of 1600 joules and a lifetime of 550 microseconds.
5. A magnetic tape recorder to store the chemical kinetics information in the form of electronic signals which may be examined individually.
6. A digital pulse integrator which gives an accurate digital representation of the intensity of the flash source signals stored on the tape.

Kinetic measurements of the homogeneous recombination of iodine atoms in the presence of argon were made in the region of a single rotational absorption line of the iodine molecule. The results agree with the work done with the low resolution kinetic investigations of iodine. They show that the multiple flash apparatus may be used to make quantitative kinetic measurements of short-lived species in the gas phase.

Microfilm $2.75; Xerox $4.40. 84 pages.

THE ADSORPTION ISOTHERM AND THE ADSORPTIVE ENERGY DISTRIBUTION OF SOLIDS

(L. C. Card No. Mic 60-2691)

James P. Olivier, Ph.D.
Rensselaer Polytechnic Institute, 1960

Research Professor: Sydney Ross

A number of model adsorption isotherms have been computed, based on the concept of a two-dimensional non-ideal gas type of mobile film adsorbed on a solid substrate that displays a Gaussian distribution of adsorptive energies. For comparison a second set of model adsorption isotherms were computed based on the concept of a localized adsorbed film on the same type of surface. These models were computed for a number of different adsorptive energy distributions of the substrate, designed to cover most physical situations. Experimental adsorption isotherms, chiefly of argon and nitrogen as adsorbates at temperatures between 77° K. and 90°K., were then compared with the computed models until the closest interpolated match was obtained. The model of a mobile adsorbed film was found to correspond better with the observations than that of a localized adsorbed film, as only the former was able to predict correctly the variation of adsorption with temperature. A number of different adsorbents were thereby shown to be described adequately by a Gaussian distribution of adsorptive energies. Other adsorbents have an assymetrical distribution of adsorptive energies, but were adequately described by the sum of two Gaussian distribution functions.

The present method of obtaining a measure of the heterogeneity of a solid surface is the first yet proposed that provides a means of checking its validity, by predicting the temperature variation of adsorption. The method also provides a new way to obtain the mono-layer capacity of a surface, which has hitherto been obtained almost universally by the B.E.T. method. The sets of computed isotherms that are appended are, therefore, a valuable key with which to unlock the adsorption isotherm.

Microfilm $2.75; Xerox $8.80. 195 pages.

THE EFFECT OF PRESSURE ON LIGAND FIELD SPECTRA

(L. C. Card No. Mic 61-1669)

Douglas Robert Stephens, Ph.D.
University of Illinois, 1961

Transition metal ions are characterized by their incompletely filled d-shell. Electronic transitions arise in many transition metal complexes due to the splitting of the d-shell of the metal under the influence of an electrostatic field provided by their attached molecules or ions (ligands). The theory used to describe this effect is called ligand field theory, or crystal field theory. This work consisted of obtaining absorption spectra of such transitions using high pressure apparatus designed in this laboratory by Fitch, Slykhouse, and Drickamer (F4), with modifications by Balchan and Drickamer (B1).

Complexes studied included $KNi(Gly)_3$, NiO, $Ni(en)_2(SCN)_2$, $Ni(\alpha - \alpha' \text{ dip})_3Br_2$, $Ni(o\text{-phen})_3(NO_3)_2$, $Cr^{+++}:Al_2O_3$, $CuSiF_6 \cdot 6H_2O$, $(NH_4)_2Cu(SO_4)_2 \cdot 6H_2O$, $FeSiF_6 \cdot 6H_2O$, K_3CoF_6, and $CsV(SO_4)_2 \cdot 12H_2O$, all of octahedral symmetry, $(\phi_4As)_2NiCl_4$, $Ni^{++}:ZnS$, $Co^{++}:ZnS$, $Co^{++}:ZnO$, Cs_2CoCl_4, Cs_2CoBr_4, Cs_2CoI_4, Cs_2CuCl_4, and Cs_2CuBr_4, all tetrahedral, $Ni(aca)_2$ and $Mn(aca)_3$. Absorption spectra under pressures to 160 kilobar were obtained. The results can be summarized as follows:

(1) Calculations of Dq for more than one transition in a complex assuming B equal to the free ion value show qualitative but not quantitative agreement. However B and Dq can be calculated from the equations of Tanabe and Sugano (T1, T2) and in general it is found that Dq increases and B decreases with pressure, as is expected. All systems where B could be calculated indicated the presence of some covalency which increased with pressure.

(2) Spin-orbit splittings for tetrahedral Co^{++} showed an increase with pressure. The pressure effect of δ/δ_o, along with Dq/Dq_o and B/B_o for Co^{++} and Ni^{++}, showed a strong dependence upon the ligand.

(3) Intensity data obtained in Cs_2CoCl_4, Cs_2CoBr_4, and Cs_2CoI_4 indicated a change of coordination from

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

tetrahedral to octahedral at about 80 kilobars. The intensity of the $^4T_1(F)$ state in Co^{++}:ZnO showed a large decrease over a pressure-induced phase transition.

(4) Polarized spectra obtained for Cr^{+++}:Al_2O_3 (ruby) indicated an increase in the trigonal field splitting parameter K above 60 kilobars. Dq and B behaved normally.

(5) The dependence of Dq upon $\frac{1}{R^5}$, where R = ligand-metal distance, was tested for ruby and for Co^{++} and Ni^{++} in ZnS, using compressibility data of P. W. Bridgman (B11, B12, B13). The agreement was quite good for ruby but was not good for ZnS. This was interpreted as due to lattice relaxation about the impurity ion and not due to failure of the $\frac{1}{R^5}$ dependence.

(6) Data were obtained on several systems exhibiting only one spin-allowed transition, equal in energy to 10 Dq. One system, K_3CoF_6, potentially could exhibit crossover of its ground state, but the pressure for this effect was not reached. It was estimated that the pressure necessary for crossover was about 200 to 250 kilobars.

Microfilm $2.75; Xerox $8.80. 191 pages.

PHOTOCHEMICAL ISOMERIZATION OF ERGOSTEROL — A KINETIC STUDY.

(L. C. Card No. Mic 61-1962)

Horatio S. Stillo, Ph.D.
Michigan State University, 1959

Major Professor: James C. Sternberg

A kinetic investigation of the photochemical isomerization of ergosterol has been carried out. The kinetic data have been obtained in solvents with a range of viscosity, but fixed chemical nature, at different wavelengths in a stirred reaction cell.

A spectrophotometric analytical procedure based on a least-squares curve-fitting technique has been developed, verified, and employed to determine the requisite concentration vs. time data. A novel photometric technique has also been developed and actinometrically calibrated to make possible the absolute determination of the absorbed light intensity as a function of time of irradiation. Combination of these data with the spectrophotometric analytical results has furnished the absorbed light intensity for each component as a function of time, making possible the elimination of the "inner filter" effect and the use of a new type of photochemical kinetic expression.

Stereochemical information and considerations of the excited states of the components of the irradiation mixture have been utilized to formulate a kinetic mechanism expressed in general and in specific terms. The general formulation is a special photochemical application of generalized first order series and parallel reaction kinetics, and has been shown to lead to expressions for concentrations of the components as linear combinations of definite integrals representing the amounts of radiation absorbed by the individual components during a given irradiation interval. In the specific cases of interest, the expressions reduce to simple linear relationships between individual concentrations and single integrals.

A comparison of the results of the kinetic runs with the derived rate expressions furnishes values for the quantum yield, ϕ_E, for the conversion of ergosterol to total products, the quantum yield, ϕ_{PT}, for the conversion of precalciferol$_2$ to tachysterol$_2$, and the quantum yield, ϕ_{EL}, for the conversion of ergosterol to lumisterol$_2$. The values of the quantum yields have been found as functions of wavelength and viscosity.

The value of ϕ_E is in accord with bioassay results and the value of ϕ_{PT} supports recent data of Havinga obtained by direct irradiation of precalciferol$_2$. This agreement with the results of investigations based on other analytical techniques substantiates both the novel photometric technique and the validity of the analytical scheme. The results also indicate that the solvent effect is truly a viscosity effect and show the direction of the viscosity dependence for ϕ_{PT} to be opposite to that obtained for ϕ_E and ϕ_{EL}. In addition, an appreciable wavelength dependence for ϕ_E and ϕ_{PT}, entirely apart from inner filter effect, is demonstrated.

An interpretation or description of the proposed mechanism has been made with the following features: (a) the optical excited state is a singlet state, (b) the optical excited state for ergosterol differs from that for precalciferol$_2$, (c) conversions occur through cross-overs of potential energy surfaces along coordinates corresponding to internal rotations, (d) the solvent exerts an effect through its viscous resistance to internal rotation, and (e) the excess energy per quantum of radiation at shorter wavelengths helps overcome the barrier to internal rotation.

An alternative non-mechanistic interpretation has been presented but is ruled out on the basis of the available data.

The results of this investigation have been utilized to suggest other studies which would help further to establish the complete mechanism.

Microfilm $3.25; Xerox $11.50. 252 pages.

SPECTRA AND STRUCTURE OF THE NITRATE AND NITRITE IONS

(L. C. Card No. Mic 61-1295)

Stewart J. Strickler, Ph.D.
The Florida State University, 1961

A simple form of molecular orbital theory was used to predict the types of transitions which might be responsible for the bands observed in the near ultraviolet spectra of nitrate and nitrite ions. A study was made of the spectra of the ions in solutions in several solvents, and the results compared with the predictions of the theory, in an attempt to identify the orbitals involved in each transition.

One possible transition in nitrate ion is a forbidden $n \rightarrow \pi^*$ transition, which has an interesting nature in that no single vibration of the isolated molecule can make the transition appear. A coupling with at least two vibrations is required. Because such a transition had never been studied, a theoretical calculation was made of the intensity to be expected from the transition in an isolated molecule. The calculated value for the oscillator strength was 3×10^{-7}.

Because of the approximations made, this value may not be more accurate than perhaps within a factor of ten. It is also several orders of magnitude smaller than the oscillator strength of any band observed in nitrate ion. However, the observed lowest energy band in the spectrum of nitrate ion is very weak, having an oscillator strength of about 10^{-4}, and it shows solvent and temperature effects which suggest that it appears due to solvent perturbation, rather than to vibrational perturbation as do most forbidden bands. The solvent shifts are like those usually associated with $\underline{n} \rightarrow \pi^*$ bands, and on this basis this band is assigned to the $\underline{n} \rightarrow \pi^*$ transition.

The second band in the nitrate spectrum is assigned to a $\pi \rightarrow \pi^*$ transition on the basis of its high intensity and the solvent shifts observed.

The case of nitrite ion is more complicated, and only a preliminary study has been made. The third band observed in the spectrum is quite intense, and from the solvent shifts it is assigned to the $\pi \rightarrow \pi^*$ transition. The solvent effects on the first band are like those expected for a forbidden $\underline{n}_o \rightarrow \pi^*$ band, but this interpretation is not consistent with other experiments reported in the literature. Another band appears only as a poorly resolved shoulder between the first and third bands. It is therefore impossible to give a definite assignment for the two lower energy bands of nitrite ion at this time.

Microfilm $2.75; Xerox $7.00. 149 pages.

THE CHELATION OF PERACIDS: A CALORIMETRIC STUDY OF ALIPHATIC PERACIDS AND PERESTERS.

(L. C. Card No. Mic 61-2070)

Howard Aldred Swain, Jr., Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. John G. Miller

Dipole moment, infrared spectroscopic, boiling point, and cryoscopic data for peracids all indicate that intramolecular hydrogen bonding occurs in these compounds between the peracid group hydrogen atom and the carbonyl group oxygen atom. The low acid strength of peracids as compared to that of the corresponding fatty acids is further evidence for chelation in peracids. In this research, a measurement of the energy of the heat of chelation of peracids was made using calorimetric techniques.

The aliphatic peracids and their t-butyl peresters and the t-butyl esters of the fatty acids used in this research were prepared and purified by the methods of Silbert and Swern, et al. The fatty acids were purified by fractional distillation in vacuo and by recrystallization. The X-ray powder method was used to determine the polymorphic form of the fatty acids as used in heat of combustion runs.

Heats of combustion were measured using an adiabatic calorimeter, oxygen bomb, and calibrated mercury-in-glass thermometers read to $\pm 0.005^\circ$F. The bomb system was calibrated using National Bureau of Standards benzoic acid as a standard. The completeness of combustion and purity of samples burned were determined by means of carbon dioxide analyses made in conjunction with the runs. The Washburn corrections were used to convert the data to the heat of combustion at 25°C and 1 atmosphere.

The total results for all of the compounds studied are large in amount and, for this reason, only the results for lauric acid and its analogues are shown here. The values given are the heat of combustion (ΔH_c°, 25°C in kcal/mole) in the solid or liquid phase, as indicated. The errors are mean standard deviations in the values and include the mean standard deviations of the runs, the carbon dioxide analyses, and estimated errors due to the use of the Washburn corrections and the heat of combustion value of benzoic acid as a standard.

Perlauric Acid	(s)	1783.7 ±1.7
Lauric Acid	(s)	1761.4 ±2.3
t-Butyl Perlaurate	(1)	2419.7 ±2.0
t-Butyl Laurate	(1)	2398.8 ±1.8

The vapor-phase heats of combustion at 25°C were estimated from the heats of combustion in the condensed phase. The heats of vaporization at 25°C of the even-numbered fatty acids and the heats of fusion of all the fatty acids used were found in the literature. The heats of vaporization at 25°C and heats of fusion of the remaining compounds studied were estimated. The extent of association in the vapor phase at 25°C for the fatty acids was estimated from equilibrium constants for the monomer-dimer relationship for the lower molecular weight carboxylic acids. The extent of intermolecular association of the gaseous fatty acids at the low pressures at which their heats of vaporization were measured was estimated as being negligible.

An estimate of the heat of chelation of peracids can be made by subtracting the difference between the vapor-phase heat of combustion of a t-butyl perester and the t-butyl ester of the parent fatty acid from the difference for the peracid and parent fatty acid. If differences in the energies of the other bonds (e.g., D_{C-H}, D_{C-C}) of the molecules and differences in resonance energy of the molecules are the same between the perester and ester as between peracid and acid, the subtraction described should give the value of the heat of chelation of the peracids.

The heat of chelation of peracids has been estimated by the method just described and has been found to be 3-8 kcal/mole with an estimated error of ±3 kcal/mole due to uncertainty of the theory. This heat of chelation includes a lowering of the strength of the O-H bond strength and, therefore, the intramolecular hydrogen bond strength in peracids should be somewhat greater than 3-8 kcal/mole. That is,

$$\Delta\text{Chel} = \Delta\text{OH} + \Delta\text{H.B.}$$

where ΔChel is the heat of chelation, ΔOH is the change in the hydroxyl group bond strength in peracids due to chelation, and ΔH.B. is the strength of the intramolecular hydrogen bond in peracids. The span in this estimated value for the heat of chelation is due to uncertainty as to the energy of intermolecular hydrogen bonding in peracids.

Microfilm $2.75; Xerox $3.80. 70 pages.

THE THERMAL DECOMPOSITION OF CYCLOBUTANE

(L. C. Card No. Mic 61-2087)

Robert Welch Vreeland, Ph.D.
University of Oregon, 1961

Adviser: D. F. Swinehart

The thermal decomposition of cyclobutane in the gas phase was investigated over a wide range of temperatures and pressures. Kinetic studies were made at temperatures of 410, 430, 450, 470, 490 and 500°C. at pressures ranging from approximately one micron to 20 mm. of mercury. The variation of rate with temperature at high pressures was found to follow the law $k_\infty = 10^{15.846} e^{-63200/RT}$ sec.$^{-1}$, which is in good agreement with the high pressure rate law found by Walters and co-workers.[1]

Heterogeneous effects were investigated by running decompositions in a flask in which the surface area had been increased by about a factor of twenty by the addition of clean Pyrex glass wool. Heterogeneous effects were found to be negligible and the unimolecular nature of the decomposition was confirmed.

The absence of chain mechanisms was confirmed by decompositions run in the presence of nitric oxide and in the presence of propylene. With either of these gases present the rate of decomposition was raised to that predicted on a total pressure basis, that is, the decomposition proceeded at a rate which was the same as that obtained with an equal initial pressure of cyclobutane.

The effect of water and air on the rate of reaction and on the nature of the decomposition products was also investigated. In both cases these gases behaved as inert gases and served only to raise the rate of decomposition back to what was expected on a total pressure basis.

Analysis of decomposition products from runs at various temperatures and pressures by gas chromatography and mass spectrometry indicated that the decomposition gave ethylene exclusively. Two very minor products were detected which were thought to be propane and butane. These were not identified conclusively. In no instance did the addition of a foreign gas have any effect on the decomposition products of cyclobutane. Reaction products not condensable in liquid air, especially molecular hydrogen, were looked for and found to be absent. Products with molecular weights above that of cyclobutane were also found to be absent by gas chromatography and mass spectrometry.

A total of 148 kinetic runs were made with the primary purpose of determining specific rate constants. The previously mentioned high pressure rate law was chosen along with a value of 5.8 angstroms for the cyclobutane collision diameter and a value of 18 effective oscillators in the molecule in order to fit the experimental rate constants to Kassel theory.

The technique used to follow the decomposition of cyclobutane with time was to monitor the reaction mixture with a mass spectrometer during the course of the reaction. This method of analysis was independent of reaction products and enabled the decomposition to be studied at pressures much lower than could be obtained by more conventional means. An all-glass system was used in all decomposition studies in order to avoid any catalytic effects one might get from metal present in the system.

A possible mechanism was suggested which was based on the breaking of one of the primary carbon-carbon bonds in the cyclobutane molecule and subsequent rearrangement of the electrons in the biradical so formed to give two molecules of ethylene.

An entropy of activation was calculated by means of absolute reaction rate theory and is reported as 10.2 cal. per deg. mole.

The average lifetime of activated molecules at various pressures was computed and these lifetimes varied from 4.6×10^{-9} seconds at 10 mm. to a limit of 5.8×10^{-3} seconds at zero pressure.

1. Genaux, C. T., Kern, K. and Walters, W. D., J. Am. Chem. Soc., 75, 6196 (1953).

Microfilm $2.75; Xerox $5.00. 96 pages.

THE STRONTIUM-LITHIUM PHASE SYSTEM

(L. C. Card No. Mic 61-528)

Frederick En-Yu Wang, Ph.D.
Syracuse University, 1960

The Strontium-Lithium phase system was investigated by differential thermal analysis and by X-ray diffraction methods over the entire range of compcsition from 100 atomic percent lithium to 100 atomic percent strontium. Limited solid solubilities were observed at both ends of the phase diagram. Three intermediate phases were found to exist with compound formula of Sr_6Li_{23}, Sr_3Li_2, and Sr_8Li. Of these three compounds Sr_6Li_{23} and Sr_3Li_2 are formed in a peritectic reaction.

The crystal structure of these two intermediate phases were studied by a combination of powder and single crystal X-ray methods. Sr_6Li_{23} was found to be a face-centered cubic with the lattice constant of $a_o = 14.88 \pm 0.03$ Å where, Sr_3Li_2 a body-centered tetragonal with lattice constants of $a_o = b_o = 9.842$ Å and $c_o = 8.761$ Å. The density of Sr_6Li_{23} and Sr_3Li_2 were determined by flotation method and found to be 1.36 and 2.15 respectively. In the range of 80 to 100 atomic percent strontium, the phase diagram is studied exclusively by high temperature X-ray methods, except for the liquidus breaks.

Microfilm $2.75; Xerox $5.80. 117 pages.

MEASUREMENT OF DISSOCIATION PRESSURES OF HYDROUS MINERALS USING THERMISTORS

(L. C. Card No. Mic 61-1963)

Cooper Harry Wayman, Ph.D.
Michigan State University, 1959

Major Professor: H. B. Stonehouse

A high temperature cell has been designed for the measurement of dissociation pressures in hydrous minerals by a newly developed method of thermistors. The vapor pressure over Gypsum was determined with an

accuracy of 7-17 per cent as compared to a manometer method. With the present experimental set-up, the thermistor method will not detect vapor pressures with any degree of confidence in substances that must be heated above 100°C.

A critical review of published thermodynamic data for Gibbsite and Boehmite was made. The dissociation pressure over Gibbsite measured experimentally does not agree with theoretically calculated curves as a result of complex surface reactions that occur during dehydration.

The application of certain concepts in physical chemistry and elementary thermodynamics to account for equilibrium assemblages of minerals in nature is discussed. Microfilm $2.75; Xerox $6.60. 138 pages.

THE THERMAL DECOMPOSITION OF AZOISOPROPANE

(L. C. Card No. Mic 61-2089)

Thomas Alvah Whatley, Ph.D.
University of Oregon, 1961

Adviser: D. F. Swinehart

Kinetic theory predicts that the rate constant for a unimolecular reaction will be pressure independent in the limit of very high pressures, but will decrease at pressures low enough that the Maxwell-Boltzmann distribution of energy is not maintained by collision. A previous investigation of the thermal decomposition of azoisopropane indicated that the reaction was probably unimolecular, but the characteristic pressure dependence of the rate constant was not observed. Instead, the reaction rate constant was pressure independent over the entire range studied, which included experiments at pressures down to 0.25 mm. There was a clear implication that if it were possible to study the reaction at still lower pressures, the characteristic fall-off of the rate constant should be observed, confirming the unimolecular mechanism.

In the present work, a mass spectrometric continuous sampling technique was utilized to extend the study of the thermal decomposition of azoisopropane down to total reaction pressures of one micron. Reaction pressures as high as 35 mm were also studied. The reaction was observed to be first order at all pressures. The first-order rate constants were pressure dependent only below one hundred microns, falling to one-half their limiting high pressure values at a pressure of about ten microns. In the temperature range 230-280° C the high pressure rate constants are given by the expression: $k = 1.37 \times 10^{18} \exp(-51{,}900/RT)\ sec^{-1}$. The decrease in the rate constant is quantitatively explainable in terms of the theory of Kassel by assuming 40-42 effective oscillators in the azoisopropane molecule.

The reaction was exothermic, as shown by temperature increases recorded by a thermocouple inserted into a well in the Pyrex reaction flask. At the highest temperatures and pressures, several kinetic experiments resulted in mild explosions. These were shown to be thermal explosions.

Eleven different products were identified and quantitative analysis carried out on a gas chromatograph. There was mass spectral indication of unstable intermediate products, the principal such product having a probable molecular weight of 156. Nitrogen, propane, propylene, and 2,3-dimethylbutane accounted for about 85% of the product mixture. Methane, ethane, i-butane, i-butylene, i-pentane, and 2-methyl-2-butene were found in lesser amounts. Hydrogen was detected as a product only of the explosive decompositions.

Low pressure experiments with added inert gases resulted in an increased decomposition rate quantitatively consistent with unimolecular reaction rate theory. Experiments with added nitric oxide resulted in a drastic alteration in the nature of the products, with propane and dimethylbutane being practically eliminated; nitric oxide was quantitatively consumed. An unstable intermediate of mass 73 was observed in the decompositions with added nitric oxide.

All of the observations were consistent with a unimolecular mechanism wherein the primary step is the production of an isopropyl radical. Subsequent reactions are proposed to be recombination and disproportionation of the isopropyl radicals. The higher molecular weight intermediates are evidence that some attack of isopropyl radicals on the parent species occurred. The occurrence of this side reaction was not sufficiently great to appreciably affect the over-all decomposition rate, as shown by experiments with nitric oxide. There thus appeared to be little or no chain character to the decomposition.

Microfilm $2.75; Xerox $7.80. 168 pages.

THE INFRARED SPECTRA AND VIBRATIONAL ASSIGNMENTS OF ETHANE-1,1-d_2 AND ETHANE-1,1,1-d_3.

(L. C. Card No. Mic 61-1336)

Hubert William Wilson, Ph.D.
University of Washington, 1960

Chairman: D. F. Eggers, Jr.

The experimental infrared vibrational spectra of ethane-1,1-d_2 and ethane-1,1,1-d_3 have been interpreted with the aid of normal coordinate analyses for both molecules.

Zero order frequencies were calculated on an International Business Machines Model 650 digital computer for ethane, ethane-1,1-d_2, ethane-1,1,1-d_3 and ethane-d_6 and were found to satisfy both the product and sum rules. The values thus obtained for ethane-1,1-d_2 and ethane-1,1,1-d_3 were then corrected for anharmonicity by a direct normal coordinate-potential energy comparison between these two molecules and ethane. These "anharmonicity corrected" frequencies, although found to be only approximations of actual experimental values, were of considerable value in the assignment of fundamental vibrational frequencies.

Prior to experimental use, the purity of the samples was ascertained by gas chromatographic, mass spectroscopic and infrared spectroscopic methods. Further purification, when necessary, was accomplished by vacuum line and gas chromatographic techniques. Finally, using a series of prism and grating instruments, the infrared region between 400 and 6000 cm^{-1} was scanned. Values, or at least limiting values in some cases, were assigned for all fundamental modes and a number of combination and overtone bands.

Microfilm $2.75; Xerox $7.80. 167 pages.

ECONOMICS, GENERAL

AN ECONOMIC APPRAISAL OF IRAQ PETROLEUM CONCESSIONS — A COMPARATIVE STUDY

(L. C. Card No. Mic 61-1395)

Hameed A. Al-Qaysi, Ph.D.
Columbia University, 1961

The problem examined in the dissertation was whether or not the petroleum resources of Iraq were efficiently and economically utilized. For this purpose, the author compared the economic features of Iraq petroleum concessions with those of petroleum concessions in Venezuela, Saudi Arabia and Iran.

The subject was approached in the following manner: Part One dealt with the forces and circumstances which shaped petroleum policy in each of the selected countries. Part Two was devoted to a comparative study of the major provisions of the petroleum concessions, namely; the area, exploration and minimum production provisions, financial obligations, integrated petroleum industry provisions, conservation regulations, employment and training obligations, duration and refining obligations. The chief emphasis in this part was on the apparent consequences of differences among countries regarding the terms of each major provision. Part Three surveyed the impact of the petroleum industry on each of the economies under study.

The study has shown that the ownership and, to a certain extent, the terms of Iraq petroleum concessions were influenced by outside powers, notably the United Kingdom. However, public opinion has been recently playing a powerful role in the acceleration of petroleum production and in the "Iraqization" of the working force of the industry. This was also true in the case of the development of concessions policy in Saudi Arabia and Iran. Since the enactment of the Law of Hydrocarbon of 1943, Venezuelan petroleum policy has been more consistent and less dependent on the wishes of those in power. In contrast to Iraq and Saudi Arabia, Venezuela and Iran (since 1957) have petroleum laws governing the granting of petroleum concessions. Venezuela and Iran have, moreover, national official agencies engaged in the exploration and production of petroleum.

In comparison to the petroleum concessions and concessionaires of Venezuela, Saudi Arabia and Iran, Iraq petroleum concessions and operating petroleum companies have their own merits and shortcomings. The absence of local refining obligations, conservation and royalty payments based on rate of return on capital, added to the existence of bilateral monopoly and long duration, are the main shortcomings of Iraq petroleum concessions. On the other hand, the size of the concessioned area, the speed of production and the employment and training activities of the petroleum companies are compatible with efficient utilization of the country's petroleum resources. Therefore, Iraq's petroleum resources could be more efficiently utilized if these shortcomings are overcome.

The study has shown, furthermore, that direct and indirect petroleum revenues have been used by the countries under study in developing the potentialities of their economies and in meeting their foreign exchange requirements. These revenues have, also, slowed down any increase in the level of taxation and have contributed towards the abolition of certain taxes; this is especially true in Iraq and Saudi Arabia. The petroleum companies' role as suppliers of cheap energy and raw material for local consumption of the four countries under study is noticeable.

Microfilm $5.65; Xerox $20.05. 442 pages.

PROBLEMS IN PRICE CONTROL: AN EXAMINATION OF THE EFFECTIVENESS OF GOVERNMENTAL CONTROL OVER PRICES IN COMBATTING INFLATION.

(L. C. Card No. Mic 60-4968)

William D. Carmichael, Ph.D.
Princeton University, 1960

This is a study of several issues concerning the use of direct governmental control over prices as a means of combatting inflationary pressures. While materials relating to World War II experience with price controls, particularly in this country and in the United Kingdom, are extensively employed, this dissertation is not simply an analysis of the history of price controls in these instances. It is, instead, an attempt to assess, in more general terms, the nature of the role of price controls in a stabilization program, the circumstances in which they may be employed, and the factors which will determine their effectiveness in combatting inflation.

The task which price controls may be called upon to perform is best understood after a careful exploration of a range of factors which will determine the course of the inflationary process in a particular instance. The major argument for the imposition of price controls is to be found in the limitations of fiscal and monetary measures in checking inflationary pressures under conditions of extreme emergency and economic strain. Under such circumstances price controls, with appropriate supporting measures, may be required if the inflationary spiral is to be checked.

The success of price controls in combatting inflationary pressures in the context of the World War II disequilibrium system is a matter of record. We must recognize, however, that several factors which contributed to the success of price controls in that context would not necessarily be present under other circumstances in which price controls might be employed. Specifically, there is strong reason for doubting that the abnormally high rate of

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

savings, on which much of the success of the World War II disequilibrium system hinged, would take place in other instances.

Some find, in the limitations of the disequilibrium system, an argument for the use of a selective rather than an across-the-board-approach in the event that price controls are once again required. A selective control program, however, would be fraught with difficulties and, at best, is feasible only with the support of extensive production controls and/or an elaborate scheme of commodity taxation.

Whenever price controls are introduced several difficult problems must be faced. The simple base-date freeze must give way, in most instances, to other types of price regulation, each with its peculiar set of merits and limitations. Rigorous standards for price adjustment actions must be developed and supported by a variety of measures, including subsidies to neutralize the effects of cost increases on the prices of cost-of-living items, price "knockdowns" in instances where unit costs have declined, and differential pricing schemes for high-cost marginal output. Techniques must be found for combatting tendencies toward undesirable shifts in production patterns induced by price controls. And a host of political and administrative problems will arise in connection with providing an adequate statutory base for controls, devising an effective administrative framework for the control program, staffing the control agency, building a field organization, and ensuring adequate enforcement and public support.

World War II experience with price controls, both in this country and in the United Kingdom, provides important lessons concerning both the pitfalls to be avoided and the techniques to be utilized in coping with each of these problems. None of these difficulties is insurmountable, but the measures required for coping with them are not simple. The effectiveness of price controls in a given situation will depend in large degree on the success achieved in developing an extensive administrative apparatus, an elaborate array of supporting measures, and the close coordination of price and production controls.

Microfilm $3.75; Xerox $13.30. 291 pages.

PUBLIC AND PRIVATE PENSION PLANS AND GROUP PREFERENCES FOR ECONOMIC SECURITY IN OLD AGE

(L. C. Card No. Mic 61-1405)

Ernest Copeland Harvey, Ph.D.
Columbia University, 1961

Americans, in attempting to implement their preferences have operated through the market, the major distributional instrument of the free enterprise system and through governmental programs. This study attempts to cast light upon the interaction of market and governmental programs for the provision of economic security in old age, to indicate the extent to which each has been utilized and to suggest the direction of future trends.

In order to develop background data for this analysis, two surveys were undertaken: a survey of Pennsylvania residents designed to ascertain the extent and source of old age protection; and a survey of business enterprises operating in Pennsylvania designed to ascertain the coverage and characteristics of private employment pension plans. Although the basic data relate to Pennsylvania, some generalizations applicable to the United States as a whole can be made because of the diversity of Pennsylvania's economic structure and the national character of the industries and unions operating in Pennsylvania.

The characteristics of the Federal Old Age and Survivors' Insurance (OASI) program--the major governmental program providing a measure of economic security in old age--were also analyzed as a means of determining the basic precepts underlying the program. In addition, the historical development of private pension plans was traced in order to ascertain the approaches to pension planning which appear to have influenced this type of market provision for economic security in old age.

The major findings are as follows:

(1) In terms of coverage and probability of eventual receipt of retirement income the OASI system is the most important of the various programs providing a measure of economic security in old age.

(2) The precepts underlying the OASI system represent the current expression of the changing, sometimes conflicting, group preferences relative to old age security: mandatory coverage; contributions by employers and employees; eligibility for benefits based upon age and covered employment rather than need; and benefits related to both earnings and presumptive need.

(3) Although the OASI tax rate is a flat percentage of covered earnings, the effective tax rate (the rate adjusted to reflect the relationship between contributions and benefits) increases with income level for incomes included in the OASI tax base.

(4) Several approaches to private employment pension planning can be isolated: the "self-interest" approach which prevailed during and prior to World War II; the "depreciation" approach which received considerable support during the period 1946-1949; the "deferred wage" approach which has been endorsed by some labor groups since 1949; and the "contingent deferred wage" approach which, although not publicly advocated by either labor or management, appears to represent most closely the current approach.

(5) The development of private employment pension plans has depended largely upon the financial position of individual firms or industries and upon the bargaining power of individual unions; although governmental actions have influenced this development, public policy has been limited to the protection of employees' interests.

(6) Two characteristics of most private employment pension plans--absence of vesting and employer control--can be expected to become collective bargaining issues and possible public policy issues.

In general, analysis of data developed in the course of this study suggests that implementation of the group preference for an income stream sufficient to meet day-to-day needs in old age, whether in the form of a governmental

program or in the form of a program provided through the market, has produced both subsidy and taxation. These tax and subsidy effects which are the result of activities of politically or economically powerful groups, are likely to persist. Microfilm $3.75; Xerox $13.30. 292 pages.

AN ECONOMETRIC ANALYSIS OF CONSUMERS' EXPENDITURES WITH SPECIAL REFERENCE TO THE EXPENDITURES FOR DURABLE GOODS

(L. C. Card No. Mic 61-1448)

William Alan Mauer, Ph.D.
Duke University, 1961

Supervisor: Charles E. Ferguson

This study has analyzed statistically a three-equation model of the consumption sector of the United States economy. Primarily it has attempted to answer two questions: (1) can consumer purchases of durable goods be adequately analyzed using time-series data? and (2) is economic significance justification enough for the inclusion of variables in a consumption function when statistical significance is lacking?

Parameter estimates, standard errors of estimate, corrected coefficients of determination, and the statistics necessary for a complete serial correlation analysis were computed for a total of 88 regression equations. The estimating method was simple least-squares, the residuals from each equation were examined for serial independence by the Durbin-Watson test, and the sample period, comprising quarterly observations, was 1948I to 1958IV.

Acceptance or rejection of a regression equation was based on two test criteria: (1) parameter estimates must have algebraic signs consistent with what one would expect on grounds of economic theory; and (2) the residuals from each equation must be serially independent.

The procedure followed in this study consisted of seven basic steps. First, a theoretical model was postulated relating consumption expenditures to a number of traditional variables, including personal income, liquid assets, lagged consumption, and population, and to a new variable, consumer anticipations. Secondly, the theoretical model was transformed into a three-equation statistical model consisting of an equation each for durable goods, nondurable goods, and services.

Thirdly, the basic statistical model was estimated and examined with the durables and the nondurables equations being rejected, and the services equation being accepted. Fourthly, a series of modifications of the basic durables equation, including the deletion, addition, and substitution of variables, and a redefinition of durables to exclude automotive expenditures, was estimated, with none meeting the test criteria. Nextly, one quarter, 1950III, was removed from the sample period and each of the modified durables equations was re-estimated; again, each was rejected.

The sixth major procedural step was the estimation of the group of nondurables and services equations which had been modified in the same manner as the durables equation. In this case, however, the results were used as evidence to support the view that statistical as well as economic significance should be the criteria for including a variable in an estimating equation.

Finally, the predictive accuracy of a number of estimating equations, derived in the second and third steps above, was determined by comparing it with the predictions of a "naive" model.

In summarizing the major findings of this study, three primary conclusions appear to be warranted on the basis of the research carried out. First, in view of the fact that not one of the 44 durables regressions estimated in this study was acceptable in light of the test criteria, it is concluded that time-series regression analysis is an unsatisfactory technique for investigating the determinants of consumer expenditure on durable goods. Furthermore, it is felt that regardless of what tools of analysis are used to investigate these determinants, a more sophisticated definition of durable goods than the one currently expounded would appear to be required.

Secondly, the results of all the regressions, but particularly those of the basic and modified nondurables and services equations, indicate that economic significance is not sufficient justification for the inclusion of a variable in an estimating equation.

The results of these regressions showed that if an independent variable by itself explained approximately 90 per cent of the variation in the dependent variable, and if this independent variable was also considered to be the most important variable in the equation, then no matter how significant, in an economic sense, other variables might be in that equation, it would be difficult to have more than one of these statistically significant.

The final conclusion relates to a secondary purpose of this study, which was to test the author's view that large-scale economic investigations are possible when no funds are available and the research worker is only nominally familiar with electronic digital computers. The successful completion of this study is ample evidence that the author's view was a correct one.

Microfilm $2.75; Xerox $6.80. 144 pages.

USE OF COMMERCIAL POLICIES FOR PURPOSES OF ECONOMIC DEVELOPMENT WITH RESPECT TO SELECTED UNDERDEVELOPED COUNTRIES

(L. C. Card No. Mic 61-1658)

George McCutchan Powell, Ph.D.
University of Illinois, 1961

The purpose of the study was to determine the effectiveness and the effects of the use of commercial policy for promotion of economic development in underdeveloped countries. With commercial policy taken to be government regulation of foreign trade and payments relations, tariffs and foreign trade subsidies, quantitative controls, and exchange controls were selected as the commercial policy instruments for study. These instruments were selected because they represent a policy area in which governments of underdeveloped countries can act unilaterally without at the same time usurping the country's international economic activities.

The significance of the study stems from the fact that, in the midst of generally inadequately developed economic institutions, much of the market exchange activity in underdeveloped countries is centered in or closely related to the international trade sector of the economy. Thus, commercial policy is applicable to that sector where a start on development has been made, yet where the market mechanism does not always guide private economic activity toward internal economic development.

It was assumed (1) that the predominant economic objective of underdeveloped countries is an increase in real national income per capita whether accomplished through the price mechanism or by other means (2) that the pattern of resource use and technology can and must be changed in a relatively short period; (3) that domestic markets are inadequate for most efficient allocation of resources, especially as between consumption and capital formation; and (4) that governments must initiate some production and stimulate desired types of private production for rapid economic development.

Chapter II elaborated these assumptions. Traditional international trade theory with its free trade policy recommendation was critically evaluated regarding its applicability to underdeveloped countries. Chapter III surveyed the nature of the commercial policy instruments, underdeveloped-country development needs, and the possibilities of coordinating commercial policy objectives in consistent pursuit of the predominant objective, economic development.

With variable effectiveness, commercial policy instruments are functionally interchangeable. Theoretical analysis in Chapter IV was designed to answer the question: Which commercial policy variants are most appropriate for fulfilling which commercial policy objectives that are in turn selected for contribution to fulfillment of development objectives? Chapter V examined the theoretical analysis of Chapter IV against the commercial policy experiences of Brazil, Chile, Colombia, Ecuador, India, Mexico, Pakistan, Peru and the Philippines during the decade 1949-1959. The primary basis of country selection was diversity in commercial policy instruments utilized.

The primary distinctions made between commercial policy instruments were their impact points, relative certainty of price and quantity effects, and flexibility of administration. Effects of commercial policies were analyzed in reference to changes in total and per capita national income or product, the volume and composition of foreign trade, international payments balances, capital movements, foreign and domestic investment, and terms of trade.

It was concluded that commercial policies for development only supplement, although significantly so, broader internal development programs and policies. The more significant commercial policy contributions to development in the selected countries have been raising significant proportions of total government revenue, changing the pattern of foreign trade toward capital accumulation and away from unnecessary consumption, and encouraging diversification in domestic production. There has been some movement toward coordination of commercial policies with greater specialization of function, i.e., tariffs for revenue, quantitative controls for control of foreign trade patterns and for protection, and exchange controls for mobilizing foreign exchange for development uses.

Development success and world economic stability will largely determine the degree and nature of future utilization of commercial policies. Tighter controls have accompanied absence of such stability and development in the past. Microfilm $2.75; Xerox $8.80. 195 pages.

CORRELATES OF PRESENT AND EXPECTED FUTURE WORK STATUS OF MARRIED WOMEN

(L. C. Card No. Mic 61-1791)

Marion Berta Gross Sobol, Ph.D.
University of Michigan, 1961

This study has two main aims. First it identifies and compares the relative importance of various economic, sociological and psychological factors which explain the current labor force status of married women. Secondly it analyzes the factors which explain the strength of married women's labor force attachment, as measured by their future work plans.

Five types of variables which influence married women's work status are covered in this analysis. They are financial (income, past income history, future income expectations), family status (number of children, age of youngest child, number of times married), past experience and training, local labor demand (local labor market conditions, place of residence) and attitudinal variables (reasons for work, life and housing satisfaction). Simple and multiple correlation techniques are used to relate these variables to current work status and future work plans. The data used comes from two cross-section studies, performed at the Survey Research Center, University of Michigan from 1954-1957.

The analysis of current work status of married women indicates the prime importance of family status in the determination of whether a wife is working. Husbands' incomes are second in importance while wives' work history prior to marriage, a factor which has never before been related to wives' current work status, is third in importance. Local labor market conditions are only important when family status considerations are taken into account. Women with no young children are more likely to work in areas of labor surplus than in areas of labor shortage. Attitudinal variables are not significantly related to wives' current work status.

Future work plans are used as measures of strength of labor force attachment. For working women, reasons for work are of overwhelming importance in the prediction of future work plans. "Accomplishment" and "time occupation" motives are far more closely related to future work plans than "working to acquire assets." Working in a family business or because "the family needs money" are intermediate in importance in the explanation of future work plans. Financial, family status, previous training and experience and local labor demand variables are not significantly related to future work plans.

For women who were not working at the time of interview reasons for work were not available. For these women the most important variables in predicting their future work status are the husband's current income and

the wife's work experience since marriage. Women who have worked since marriage are far more likely to work in the future than those who have not worked since marriage. Further, women who are currently working are far more likely to expect to have work careers in the future than women who are not currently working.

A number of conclusions valuable for prediction and analysis can be drawn from this study. (1) The results of the multivariate analysis indicate that predictors should take into account simultaneously economic, sociological and psychological factors when they make estimates of labor force participation of married women. (2) Work experience prior to marriage is a good guide to work experience after marriage. The increase in work experience prior to marriage (despite trends toward earlier marriage and higher educational levels) forecasts an increase in the labor force participation of married women in the future. (3) Reasons for work are more important in predicting strength of labor force attachment than any other variables. Further psychological and sociological reasons for work are more closely related to strong labor force attachment than financial reasons for work.

Microfilm $2.80; Xerox $9.70. 214 pages.

SERVICING UNITED STATES DIRECT FOREIGN INVESTMENT

(L. C. Card No. Mic 61-2088)

Donald Addison Wells, Ph.D.
University of Oregon, 1961

Adviser: Raymond F. Mikesell

United States direct foreign investments confer benefits and impose costs on capital-importing countries. It has been argued frequently that the costs of United States direct foreign investments are too great relative to the benefits which are received, and that the costs have not been fully assessed and probably have been underestimated. The principal costs to the capital-importing countries are the income remittances to the foreign investor and the costs associated with the adjustments in the domestic economy and the balance of payments which accompany these payments.

The discussions in the economic literature which emphasize the costs to the host country of servicing United States direct foreign investments have been piecemeal in that they have focused on individual aspects of the costs and benefits of these investments. There has been no comprehensive and systematic assessment of the over-all impact of direct foreign investments on the servicing of these investments. It is the purpose of this dissertation, first, to define these costs and benefits and to put them into perspective and, second, to provide an analytical framework for examining them systematically. Previous studies have concentrated on the costs as measured by income payments to United States investors; in this dissertation an examination is made of all foreign exchange payments and receipts of the host country which are associated with United States investments. Also, it is emphasized that the costs and benefits of United States direct foreign investments which have been associated with the adjustment process are meaningful only in relation to national economic objectives. For the less-developed countries the primary goal has been to achieve an accelerated economic growth and to minimize unemployment. The impact of United States direct foreign investments and the adjustments accompanying them have been assessed in terms of these goals.

Statistics on United States direct foreign investments have been gathered from official publications of the United States Government, the United Nations, other international organizations, and foreign governments. The principal sources for the attitudes toward United States investments are foreign legislation relating to foreign investment, scholarly journals, the United States and foreign press, and official statements of foreign governments of their spokesmen. Case studies and other descriptions of the experience of United States firms abroad have been utilized in assessing the non-quantitative impact of these companies on the economies and the balance of payments of the host countries.

The principal conclusions are:

(1) United States direct foreign investments as a whole make a net contribution in foreign exchange to the less-developed capital-importing countries. However, the operations of most United States manufacturing companies abroad result in an excess of foreign exchange payments over foreign exchange receipts.

(2) Many of the costs associated with the servicing of foreign investments are costs which accompany efforts for achieving accelerated economic growth. The relevant question is: are the costs associated with foreign investments greater than the costs associated with alternative means of achieving accelerated economic growth? Criteria which are used to screen foreign investments should not be applied in isolation but should be integrated with the policies which attempt to ensure that total investments, both foreign and domestic, make the greatest possible contribution to meeting the economic needs of the country.

(3) In recent years efforts by capital-importing countries to encourage local equity participation in foreign concerns and the increasing tendency to utilize licensing and other agreements in order to obtain the benefits of foreign resources have helped capital-importing countries to reduce their investment service costs.

Microfilm $2.75; Xerox $7.20. 154 pages.

ECONOMICS, AGRICULTURAL

INTERREGIONAL COMPETITION IN THE PRODUCTION AND PROCESSING OF TABLE BEETS

(L. C. Card No. Mic 61-1837)

David Lincoln Call, Ph.D.
Cornell University, 1960

In recent decades important shifts have taken place in the geographical pattern of production of many processed vegetables. These shifts in production, due to many complex forces commonly described as "Inter-regional Competition," pose many problems for producers and processors.

The main purpose of this research was to provide more basic and complete information on the nature of interregional competition in the beet processing industry. A secondary objective was to develop a methodology which might simplify the analysis of the competitive position of other processed vegetables.

Procedure

Data on farm production, cost of processing and marketing of canned beets was obtained from growers and processors in New York, Wisconsin, Texas and Oregon. These four areas commonly produce about 95 per cent of the beets.

Cost of processing information, based on a uniform accounting system, was obtained from a sample of processors in New York, Wisconsin and Texas. With these data it was possible to determine the present cost structure of the industry in each area and major reasons for differences in costs between areas. Using transportation costs and information on the marketing pattern it was possible to delineate the primary and secondary markets of each producing area. Those factors which are likely to be of major importance in altering the present competitive position of each area were determined and estimates of future changes in the industry were made.

Results and Conclusions

The forces affecting interregional competition are many and diverse. Differences in costs obviously reflect these diverse elements. Considerable variation among areas was noted in raw product cost, labor efficiency, wage rates, overhead costs and several other less important items. Labor and raw product cost, which account for about 30 per cent of the total cost of processing a case of red beets, are the major items over which the processor has some control. The cost of the other factors such as cans, cases, overhead and other items are relatively fixed from the standpoint of the individual processor. Anything which causes the labor or raw product cost to change unequally between areas will probably result in changes in relative profitability. If the relative profitability of beet production changes significantly, changes in the present geographical pattern of production will take place.

The average beet processing costs were about equal in New York and Texas, but significantly lower than in Wisconsin. New York processors had a lower labor and overhead cost than the Wisconsin processors. Texas processors had a higher can cost than New York but this was offset by a lower overhead cost. With FOB prices about equal in New York and Wisconsin, and Texas prices about 10 per cent lower than these two areas, there are significant differences in the present profitability of canned beets. Although beet production has been most profitable in New York there has not been a decided tendency for beet production to increase in New York. Due to the lack of more profitable alternatives in Wisconsin and Texas and the practice in the industry of continuing production as long as out-of-pocket costs are covered, beet production has not decreased significantly in these two areas.

Although reported farm prices varied substantially among these three areas, raw product cost per case was about equal due to variations in acquisition cost, case yield and quality.

New York processors appear to be in the best position to maintain or improve their competitive position with respect to raw product cost due to the advanced technology and highly specialized nature of farm production in that area. In the long run, the Texas processors appear to be in the best position to maintain relatively low labor cost. Changes in relative labor cost will depend primarily on possible union activities, changes in minimum wage laws and the availability of capital for investment in labor saving equipment.

In the next decade New York and Texas will provide Wisconsin with increased competition. Gradually production will increase in these areas at the expense of Wisconsin. Microfilm $4.80; Xerox $16.90. 375 pages.

A STUDY OF RESIDUAL INCOME AND LAND VALUES ON WISCONSIN FARMS

(L. C. Card No. Mic 61-1522)

Grant Leland Cornelius, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Raymond J. Penn

Land values in recent years have risen while net farm incomes have fallen. This has occurred as farmers have reacted to falling incomes by attempting to increase farm size. Operators of uneconomic units who continue to farm are faced with the alternatives of no adjustment in firm size and a declining economic position, or adjustment in firm size and transference of income normally accruing to labor and non-land capital into land values. Neither choice achieves adequate adjustment in agriculture because families in these situations continue to be low income families.

The purposes of this study were to determine the level of returns to the factors of production on farms of different earning capacities, to compare land income and land values to ascertain at what level of farm organization pressure exists on land values, and to analyze the findings. Farms were budgeted both as complete operating units and as expanded units. Data on Economic Classes of farms from the Census of Agriculture were used as the primary basis for developing the farm budgets. Two levels of expansion efficiency were budgeted into the farms.

It was found that on the three smaller Economic Classes of farms (IV, V and VI) income generally is transferred from labor and capital into land values. This is true whether the farms are operated as complete units or as units expanded to the next higher Economic Class. No income transference from labor and capital into land values occurs as Class II and III farms are expanded. Pressure on land values can readily come from these two levels of farm organization when only the residual income to land is bid into land values.

The findings of the study have application to at least four areas: (1) The Conservation Reserve, (2) Farm Credit, (3) The taking of land for the Interstate Highway System, (4) The low income problem in agriculture.

The Conservation Reserve has had several beneficial effects on agriculture: it has improved agriculture's income position by reducing the supply of agricultural

commodities; it has stabilized the income of owners who have placed land in the Reserve; it has made the transition out of agriculture easier for some farm people. On the other hand, because it has reduced the supply of land, the Conservation Reserve has made adjustment more difficult for the man who continues farming. If the Conservation Reserve is renewed, agricultural adjustment will be more effectively achieved by renting entire small farms than by renting part or entire large farms.

If farm adjustment serves as a guide in making credit available to farmers, it is inadvisable to lend money for the purchase of Class IV, V or VI farms to be operated as complete units. Farmers on small farms wishing to adjust may find it more profitable to expand at the intensive rather than the extensive margin.

The most useful concept in determining the value of land taken under the Interstate Highway System seems to be the difference in farm value before and after the taking. Other generalizations are difficult to make because of productivity differences in land plus other characteristics that tie it uniquely to a farm unit.

Institutional rigidities and the competitive framework of agriculture make the low income problem in agriculture more than a credit and information problem, more than one of inadequate decision-making. If headway is to be made toward resolution of agriculture's low income problem, then an improvement in the farmer's decision-making process offers the greatest possibilities.

Microfilm $2.75; Xerox $5.40. 108 pages.

FARM ORGANIZATION AND RESOURCE FIXITY: MODIFICATIONS OF THE LINEAR PROGRAMMING MODEL.

(L. C. Card No. Mic 61-1948)

Peter Edward Hildebrand, Ph.D.
Michigan State University, 1959

Major Professor: Glenn L. Johnson

In this thesis, the standard formulation of the linear programming model is modified so that the productive resources of the firm are fixed endogenously rather than being arbitrarily fixed at a predetermined level. A resource is fixed for the firm if the acquisition price of another unit is greater than or equal to its marginal value productivity, which in turn is greater than or equal to its salvage value to the firm. Resource fixity in this model is subject to the above condition, the credit supply function of the firm, the initial level of the resource and the level of technology considered available to the firm.

In addition to the model, and in the absence of precise discrete programming procedures, a rule is devised for obtaining discrete investment levels for the resources acquired or sold in the solution. The rule is based on the concept of fixed assets incorporated in the model.

In the application of the model to a firm, the problem of varying the stock of durable resources and allocating the annual flow of their services is encountered because the objective of the analysis is to determine an optimum organization of the firm which maximizes annual net revenue. The acquisition and salvage values of the annual flow of services from a resource are regarded as the annual cost of ownership of the stock. The annual cost of ownership of a durable stock is the sum of the annual depreciation, interest, repairs and taxes on the resource.

The model is applied to a 160 acre South-central Michigan farm which is initially organized as a dairy farm with 32 cows and their replacements, a 32 stanchion barn meeting grade A market requirements and a full line of crop machinery. The model is sufficiently flexible to consider the following range of possible solutions: 1) selling the farm, investing the capital at 4 per cent interest and obtaining off farm employment; 2) a generalized dairy farm similar to the initial organization; 3) a milk-factory type of organization with all the feed purchased and 4) a cash crop farm with no dairy. Expansion of the firm is limited by the credit supply function of the farmer and a reasonable limit to the amount of land available for purchase.

The prices on items which can be purchased are 1958 prices uniformly inflated by 10 per cent. The prices received are $3.90 per hundredweight for milk, $0.90 per bushel for corn and $17.50 per ton for hay.

The final farm organization obtained from the model and the application of the rule for discrete investment levels, is a 320 acre cash crop farm with 13 acres of oats, 39 acres of hay and 216 acres of corn on the 268 tillable acres. The dairy was unable to compete with the cash crop alternative so the dairy herd was sold.

The model is constructed under the assumptions of static economic theory. As such, it does not consider the functions of management, situations of rish and uncertainty, nor formal and informal insurance schemes.

Microfilm $2.75; Xerox $5.00. 99 pages.

EFFECTS OF ECONOMIC ADJUSTMENTS ON THE SUPPLY OF MILK FROM FARMS IN NORTHEASTERN ILLINOIS

(L. C. Card No. Mic 61-1634)

Max Raymond Langham, Ph.D.
University of Illinois, 1961

Quantities of milk from profit maximizing farm plans were used to estimate the optimum supply response of milk producers on farms differentiated by crop acre size and stanchion capacity available. In each of six strata of farms, the quantity of milk produced at selected milk and hog prices were used to define (by least squares) supply response functions of the general form: Quantity of milk = f (price of milk, price of hogs). Response elasticities were computed from these functions.

Aggregate quantities of milk at each combination of selected milk and hog prices were obtained with the formula $\sum_i Q_i K_i$, where Q_i is the quantity of milk produced on the typical farm in the ith stratum and K_i is the number of farms in the ith stratum. These price-quantity relationships were used to define an aggregate supply function. Such aggregation assumes no farm-market or inter-farm interaction in products or factors. Information on such interaction would permit a more precise aggregation.

Data from farms in random sample of areas (in Boone, DuPage, Kane, Kendall, Lake, McHenry and Will counties)

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

were used to establish resource restrictions for the model (linear programming) used to solve for profit maximizing farm plans and to define farm strata. Farm record, experimental, and survey data were used to define technical coefficients. Market hog prices were varied from $11.60 to $19.10 by $1.50 increments. At each of these six hog prices, milk prices were varied from $2.70 to $5.10 by $.40 increments. Other price estimates were for 1965.

On farms with ≥170 crop acres and ≥35 stanchions beef price, cow quality, and labor supply were varied to determine the effects on the response of producers.

Data generated by the model were sufficient to estimate optimum milk supply response functions on farms with <170 crop acres, <35 stanchions; <170 crop acres, ≥35 stanchions; and ≥170 crop acres, ≥35 stanchions. In each of these strata, the response was more elastic w.r.t. milk price than would be expected from earlier studies. The higher elasticities of this study are, at least partly due to the many production alternatives available to area farmers, to abundant capital resources, and to the optimality rather than to the actuality of the results. At a given milk price, the elasticity w.r.t. hog price changed from slightly positive to highly negative as hog prices were increased from $11.60 to $19.10.

The aggregate response of all farms was very elastic w.r.t. milk prices. The elasticity decreased, but never fell below 9.05, as the milk price expectation was increased. This high elasticity was mostly due to the entry of nondairy farms into milk production at the higher milk prices.

A less elastic milk supply response w.r.t. milk price was obtained when beef prices were varied than when held constant. Optimum response at each of three cow qualities indicated that farmers with highest quality cows would be least responsive to expected price changes. The opportunity to hire additional labor made the supply response more elastic.

The competitive position of the dairy enterprise varies widely on farms of different sizes and with different fixed investments in dairy facilities. The study suggests and/or supports the hypotheses that farmers with (1) more crop acres and/or (2) fewer dairy facilities have a more elastic supply response, w.r.t. milk price, than do farmers with a smaller number of crop acres or a larger number of dairy facilities. With respect to hog prices, the same hypotheses hold.

Microfilm $3.20; Xerox $15.75. 248 pages.

USE OF QUEUING THEORY IN DETERMINING OPTIMAL SUPER MARKET CHECK-OUT FACILITIES

(L. C. Card No. Mic 61-1956)

John Yaotung Lu, Ph.D.
Michigan State University, 1959

The check-out service provided by a super market appears to have all the necessary features that make up a typical queuing problem. There are customers who demand service; as each customer reaches a service channel, he receives a service. After a certain service time, he leaves. If the service channel is not immediately available to him, he joins a queue. In most cases, the management has little control over the arrivals of customers to the service area either in quantity or in time; it can, however, expand or contract facilities to meet a certain prespecified optimum criterion. The problem involves a balancing of the cost incurred by providing a certain amount of check-out facilities for a given period of time against the cost of losing customers in the future because of inferior service standards.

Recent developments in queuing theory provide the basis for systematically and quantitatively analyzing such a problem. The procedure is to first estimate, for given incoming traffic pattern and service practice, the probability distribution of the check-out system's being in each of all the possible states which are specified by the number of customers present in the system. Next, the cost associated with the system in each state is calculated. When the cost as well as the probability of the system being in each state is known, the expected cost per unit time of operating the check-out service under given conditions can be calculated. This process is repeated until the conditions which would result in the minimum expected cost are found.

The formal model used to estimate the state probability distribution is characterized as follows:

Input – the number of customers arriving per unit of is a Poisson variate.

Service mechanism – the time required to serve a customer at a counter follows one of two different negative exponential distributions depending on whether or not a package boy is assisting a checker.

Queue discipline – "first come, first served."

This procedure was applied to data obtained at one of the large super markets in the Detroit area. The week was subdivided into five periods. The state probability distribution was estimated for each period and the quantities of interest such as the expected length of queue and the probability of more than a certain number of customers in a queue were calculated. Based on these quantities, expected costs were obtained and the service facilities which would generate the minimum expected cost were found.

Sensitivity of the choice of optimum service facilities to changes in estimated average arrival rate and average service rate was examined and was found not to be serious. The assumptions of Poisson inputs and exponential service times were tested. The number of customers arriving at the check-out area per unit of time follows closely a Poisson distribution. The negative exponential distribution did not appear to give the best fit to observations on service time. The assumption that service times are distributed by a gamma function was found to be more plausible. An alternative procedure based on the Monte Carlo method was proposed to take account of this fact.

Microfilm $2.75; Xerox $4.60. 89 pages.

ECONOMICS, COMMERCE – BUSINESS

AN ANALYSIS OF MARKETING CURRICULA IN AMERICAN COLLEGES AND UNIVERSITIES

(L. C. Card No. Mic 61-1312)

William Frederick Barber, D.B.A.
University of Washington, 1960

Chairman: Warren W. Etcheson

The continuing growth of business schools places an increasing burden upon marketing educators to carefully define the purposes of a marketing curriculum and to see to it that these purposes are being met. This dissertation is designed to aid in this process. It has as a purpose to evaluate present marketing curricula in American colleges and universities with regard to the purposes of marketing education and the needs of society and the individual. In doing so it is necessary to study the extent of collegiate marketing education and to analyze both past and future trends.

The material developed indicates various failings of present marketing curricula. Segmented majors, proliferation of courses, over-specialization, absence of any marketing requirements in many schools, outmoded courses, excessive duplication, and the neglect of the fundamentals and general education occur with varying degrees of frequency at a great many colleges. These weaknesses support the charge that marketing curricula in some institutions of higher learning may not be fulfilling their intended educational purposes or satisfying the needs of society or the students. A dynamic concept of marketing education is needed so that these weaknesses can be remedied by appropriate action.

Microfilm $3.75; Xerox $13.05. 290 pages.

A CRITICAL ANALYSIS AND APPRAISAL OF SUPPLEMENTARY COST CONTROLS FOR INVENTORIES

(L. C. Card No. Mic 61-1361)

Don Theodore DeCoster, Ph.D.
The University of Texas, 1961

Supervisor: Dr. G. H. Newlove

The primary purpose of this study was to investigate logical bases for controlling manufacturing inventories. The underlying premise of the inventory controls developed was that scientific methods are reliable. A mathematical approach was utilized with the goal of achieving an optimum solution. The attempt has been to formulize and place in step-by-step order the methods available for scientific inventory planning and control. While the approach is mathematical in nature, the techniques are not as involved as the advanced mathematical methods common to operations research. Study of the controls was from the viewpoint of adaptation by small businesses.

Many of the strides that have been made in inventory control have come from the engineering and management areas. Generally, these new techniques have not been adopted into accounting methodology. An evaluation of these techniques was made (1) to determine the appropriateness of adopting the methods, (2) to develop quantitative illustrations of sufficient depth and breadth to indicate their absorption into an operating situation, and (3) to analyze their strengths, weaknesses, and limitations. The evaluation also includes an analysis of the effect upon the organizational structure that might result from the integration of these inventory control techniques.

The major contribution is brought out through the illustrations that are included. For each inventory control device an illustrative problem with a step-by-step solution is developed. This solution is such that the technique can be readily adopted into the practical setting.

The emphasis is directed in four areas. Activity analysis, the first area, consists of the examination of the utilization of the items within the inventory. The quantitative measures are established to identify for planning and control those items which experience the greatest activity. This is the most basic analysis used in controlling inventories. The second area of the thesis deals with quantity analysis. Quantity analysis employs the application of methods designed for the determination of the amount of inventory to be maintained. This analysis includes consideration of how much to purchase or produce under various economic and operating situations. The third area is devoted to a consideration of planning and control techniques for the work-in-process inventory. From the control point of view work-in-process inventory generally is the most neglected of the three inventories within a manufacturing concern. The typical cost system is concerned only with the determination of unit cost and control of the actual production departments. This does not assure that the work-in-process inventory is optimum in terms of total value, process time, and quantity. As a corollary study, material handling costs are also analyzed. The fourth broad area considered involves techniques that can be used for the measurement of the efficiency of management in the areas of material and inventory activities. The discussion develops efficiency measures for each of the principal organizational units responsible for materials. These broad areas provide controls for the inventories from the purchase until the completion of the final product.

Traditionally the handling of inventories has been accomplished by "rule-of-thumb" and "trial and error" methods. Other management areas such as capital investment have advanced to more scientific approaches of problem solving. The advantages of these scientific methods is that they provide a consistency of solution. This consistency insures that two similar problems would be solved with similar results. The mathematical approach provides a definitive result which gives management an objective starting point for its decisions.

Microfilm $4.10; Xerox $14.40. 317 pages.

AUTOMATION IN FOOD MARKETING -- SELECTED CASE STUDIES

(L. C. Card No. Mic 61-1922)

Charles Raymond Goeldner, Ph.D.
State University of Iowa, 1961

Chairman: Professor William A. Knoke

The purpose of this study of automation in food marketing was to determine the extent and affect of automation in food distribution.

The study begins with a survey of the literature, then proceeds to a more specific study of six food distributers, four at the wholesale level and two at the retail level.

Part II considers the wholesale level of food distribution and reveals automation has advanced rapidly in the area of electronic data processing and automatic warehousing. The first three case studies deal with the computer installations of Associated Grocers, Phoenix, Arizona; Certified Grocers, Los Angeles, California; and Young's Market Company, Los Angeles, California. The findings suggest that computers were desirable for order writing, billing, inventory control, sales control, sales analysis, payroll, and accounts receivable. The greatest impact of the computers on the operations of these wholesalers was in the area of control. Information and reports are now accessible to aid in making decisions and carrying out marketing functions. In each of the cases, the computer made a contribution toward lowering distribution costs.

The automatic frozen foods warehouse of the Jerseymaid Milk Products Company was the fourth case studied. The findings of this study revealed: (1) a part automatic, part manual warehouse is feasible, (2) order filling speed can be greatly increased, and (3) substantial labor savings result.

Part III deals with the retail level of food distribution. Areas of automation at the retail level are: (1) electronic stores, (2) vending, (3) electronic data processing, (4) gravity feed, (5) automatic checkout counters, baggers, and other devices. Automation at the retail level is relatively undeveloped because most of the equipment is still in the experimental stage. There is considerable promise, however, that more automation can be achieved.

Two case studies appear in this section. The first reports an experiment by Independent Grocers Alliance and Multi-Vend, Incorporated, to sell groceries through vending machines located by a supermarket. This study led to the conclusion that while it is possible to provide customer service and convenience with fewer store hours it is doubtful that vending will ever become a major method of grocery buying by consumers.

The last case study deals with a Food-O-Mat installation at the Brice Brothers Supermarket in Belvedere-Tiburon, California. Food-O-Mat is an automatic merchandising display fixture utilizing gravity feed. It is the nearest thing to an automatic stocking device in the supermarket today. This study indicated that the equipment can gain additional floor space, save on labor costs, increase the rate of inventory turnover, and increase profits.

An examination of automation in the case studies, personal interviews, letters, and literature led to the following conclusions:

1. Automation in food marketing will continue to grow, having an increasingly greater influence and effect.
2. Automation will reduce distribution labor costs.
3. Automation will result in the selling function becoming more impersonal, with a trend toward more advertising and preselling.
4. Information produced by electronic systems will enable the merchandising and buying functions to be performed more efficiently.
5. Automation's greatest impact will be in the area of sales control. Reports will be furnished management which will provide them with information necessary for control purposes.
6. Automation by retailers and wholesalers will accelerate a trend toward standardization of packages and shipping cases by manufacturers.
7. Automation will result in marketing institutions increasing in size. Outlets handling large volumes of merchandise can justify more automatic equipment than smaller operations.
8. Automation will lead to a change in the traditional channels of distribution. Lower margins will cause the higher-cost channels of distribution to lose volume.

Microfilm $3.50; Xerox $12.15. 269 pages.

THE REGULATION OF COMMERCIAL HEALTH INSURANCE FOR THE INDIVIDUAL

(L. C. Card No. Mic 60-3656)

John W. Hall, Ph.D.
University of Pennsylvania, 1960

Supervisor: Dr. Dan M. McGill

The volume of individual health insurance (especially medical care expense as opposed to income replacement insurance) has grown rapidly in recent years. The motives for this rapid development are two: (1) the competitive desire to expand in what is considered, by many, a profitable line, and (2) a greater feeling of responsiveness to the health insurance needs of the public. The increased feeling of responsiveness stems from the increased social interest in health insurance – an interest which has manifested itself in a greater demand for commercial insurance (individual and group), and also in demands for temporary non-occupational disability insurance legislation, continuous pressure for the extension of social security into the income replacement and medical care expense fields, and increased criticism and regulatory activity. Most of these manifestations have been cause for grave concern within the industry. This study is concerned with the latter of these manifestations, i.e. the regulation of health insurance sold to individuals (rather than groups) by commercial insurers.

In this country, where governmental quests for control and power are at a minimum, intervention into the affairs of business, through governmental investigation and regulation, does not occur until it can be demonstrated reasonably that the public interest is not being served. Charges that an industry is violating the public interest may be derived largely from misuse, real or imagined, of the

trust placed in that industry by those relying upon its products or services, or from other industries (or businesses) who feel that their position and security are being unfairly imposed upon. Both are important past and potential sources of criticism in insurance; both are past and potential reasons for governmental intervention.

Despite the growing importance of governmental regulation in the health insurance field, there is no adequate source of information on, or analysis of the subject. Most students of insurance and administrative government have neither the time nor the opportunity to seek detailed information from the many primary and secondary sources available. This study is offered as a comprehensive analysis of regulation (self-regulation and governmental regulation) as it is related to this important segment of the total insurance industry. Because of the dynamic status of insurance and its regulation, it is necessary to establish mid-1959 as the termination date of this study.

The study is divided into four parts. Part I, "Introduction," is a review of the need for health insurance, and more important, a survey of the nature of commercial health insurance for the individual. This background material was included on the assumption that those persons in a position to influence decisions in the field of health insurance regulation must base these decisions upon a minimum knowledge of the subject matter to be regulated.

Part II is devoted to an analysis of voluntary self-regulation. Particular attention is devoted to the techniques and activities of self-regulation as practiced by the Health Insurance Association of America.

The body of the study is an analysis of state regulation. Part III includes a discussion of the constitutional or legal status and the general nature of state regulation, together with a detailed analysis of the regulation of the health insurance contract, rates, unfair trade practices and advertising, reserves, and unauthorized insurance. An effort is made to show interrelationships and place each of these topics in its proper historical perspective.

Part IV, Conclusion, contains both a critique of individual health insurance and some observations concerning the future of health insurance regulation. The critique is an attempt to evaluate objectively the individual health insurance business and is designed to aid the reader in evaluating the current pattern of regulation.

Microfilm $10.20; Xerox $36.35. 808 pages.

THE DEVELOPMENT OF THE CONCEPT OF THE PRODUCT ASSORTMENT IN THE LITERATURE OF ECONOMICS AND MARKETING

(L. C. Card No. Mic 61-1641)

Frederick Armand Manzara, Ph.D.
University of Illinois, 1961

The product assortment is a heterogeneous collection of products designed to meet the needs of some behavior system. The assortment has the characteristics of mass, which establishes the assortment in space, durability, which establishes it in time, and potency, which establishes it in the expectations of consumers. The assortment has potency or value insofar as it prepares the consumer to take appropriate action in anticipated contingencies. The products in the assortment are gathered for future use and do not have value until that use is implemented. The purpose of this study is to examine the significance of the product assortment for theories of consumer choice as found in the literature of economics and marketing.

A choice exists when alternative courses of action may be taken under conditions where some uncertainty exists as to the best possible course. If there is one course known to be superior for the attainment of the goal sought, assuming the consumer to be rational, that is the course to take. There is no real choice. The interactions of the products in the assortment introduce an element of uncertainty, so that the consumer has some choices and the assortment has some influence on these choices. These choices may involve the addition of products to the assortment, the deletion of products from the assortment, the maintenance of products in the assortment, or the rearrangement of these products.

The assumptions of the Classical economists minimized the element of consumer choice in their theories. Owing to competition a subsistence level was posited and the consumer could amass no surplus. The concept of the product assortment was not recognized, so it could have no influence on purchases or wants.

The Marginalist economists assumed that the individual knew his own utility scale, the types and quantities of products available, and his own resources. As a result, he had no real choice, he purchased that which would allow him to maximize satisfaction from his resources. The only influence of products was the exposure of the next want on the scale through satisfaction of the last. The thought of Marshall makes a beginning to the notion that products have some influence on character and wants through the influence which they have on activities.

Twentieth century thinkers in economics advanced the idea that the requirement of life itself is to act, and that in order to act products are needed. The product is acquired prior to the need for it rather than after the need becomes apparent. This introduces some uncertainty into the theory and gives the consumer the opportunity to make a rational choice. The products to be used might actually influence the needs for them. If activities can be influenced through the use of products, the matter of economic choice might come within the scope of managerial influence.

The marketing literature duplicates the economics literature in many respects, but does make one important advance. The marketing manager tries to match the image of his product to the self-image of the consumer. He influences choice through management action, recognizing that the product is not only a physical entity, but a complex of symbols, hence a communication device. The important requirement is to know the ways in which products influence behavior so that innovations in assortments and activities may be directed and controlled.

Microfilm $3.15; Xerox $11.05. 241 pages.

THE IMPACT OF INTEGRATED DATA PROCESSING ON ORGANIZATION STRUCTURE

(L. C. Card No. Mic 61-1370)

Melvin Eugene McMichael, Ph.D.
The University of Texas, 1961

Supervisor: Dr. J. K. Bailey

This study first identifies trends in the development of integrated data processing (referred to hereinafter as I. D. P.) and the "total system" of integrated data processing and then examines the impact of such trends on the business organization structure. Answers to these questions are sought:

1. What effects are I. D. P. systems and the "total system" concept having on the traditional functional organization structure?
2. What effects are such systems having on the personnel of the business organizations?
3. What new departments are evolving as a result of I. D. P. and the "total system" concept, and what is the authority and responsibility of the managers of these departments?

I. D. P., as used in this study, is the coordinated and uninterrupted flow of data from their point of origin to the point where management is provided essential information. The data are typically translated into a coded medium at their source with mechanical and electronic equipment being employed wherever they aid in uniting the separate data handling operations into an uninterrupted whole. A firm may develop a "total system" by merging its separate I. D. P. systems so that one integrated system feeds significant information to other integrated systems as the information flow occurs throughout all parts of the enterprise. The economic principle which provides the focal point of the "total system" concept is that a business enterprise operates as an economic whole so that a decision in one area of the organization ultimately affects in some way all other areas.

The study of changes resulting from introducing better methods of data processing required that adequate information be collected from a substantial number of firms involved in introducing I. D. P. and developing a "total system." Five companies, each of which was developing I. D. P. systems, operating in a different industry, and of a different size, were examined in some detail. The executives of the five companies provided information concerning the methods used in introducing I. D. P., the present organizational developments resulting from this introduction, and the proposed changes in the organization with the continued development of I. D. P. and the "total system." In addition to the five detailed company studies, a questionnaire was mailed to a total of 185 companies thought to be using electronic digital computers and developing I. D. P. systems.

The study revealed a more widespread development of I. D. P. systems within business organizations than had been anticipated. Some of the companies indicated that their I. D. P. effort was not as fully developed as that described in the questionnaire since much of the data was presently not coded until it reached the proximity of the Data Processing Department. A large number of the responding companies indicated that they are presently developing a "total system" or planning to develop one. In most of these companies the development of a "total system" was not a short run objective but one which would be progressively accomplished over a period of years.

The study revealed that I. D. P. was causing the elevation of certain departments to positions of greater organizational importance. A new department known, with some variations, as the Data Processing Department was evolving in most companies that had developed I. D. P. systems. The increasingly important contribution of the Systems Department to the development of I. D. P. was paralleled by the growing significance of this department in the organization structure.

I. D. P. is definitely causing a general reduction in the number of clerical personnel in most of the participating companies. Some of those companies which had not experienced a reduction in the number of clerical personnel indicated that the increase in clerical personnel following the expansion in their volume of business was restricted by the introduction of I. D. P. systems.

The study revealed that changes are occurring in middle management as a result of the introduction of I. D. P. systems which, by their nature, transcend the traditional vertical divisions of the organization. The middle management personnel in accounting, production, and sales, were the groups most affected by the introduction of I. D. P. systems. Some of the previous responsibilities and the correlary authority of middle management is reduced or removed as the work is transferred to the data processing department. The remaining middle management appears to have been given greater responsibility for business decisions.

Microfilm $4.45; Xerox $15.75. 346 pages.

SELECTED PROBLEMS IN THE RAPID DEVELOPMENT OF THE COTTON TEXTILE INDUSTRY IN PAKISTAN

(L. C. Card No. Mic 61-2059)

Riazur Rahman, Ph.D.
University of Pennsylvania, 1961

Supervisor: Gladys L. Palmer

The purpose of this dissertation is to illustrate by a case study some of the important problems of economic development which an underdeveloped country, such as Pakistan, faces during the early stages of industrialization. The historical development of the cotton textile industry from 1947 to 1959 furnishes an example to show that while the presence of some factors, such as the existence of adequate supplies of domestic cotton and of consumer demand, favored the expansion of the industry, the lack of others, especially human skills, proved to be a hindrance to its adequate development. The main areas covered in the study are: the history of the industry, its emergent structure, labor and management problems, and the role of Government in its growth.

In outlining the history of the industry, special attention is given to the factors which hindered its development in early stages and led to a rapid expansion of capacity and

production in later years. Problems faced by the industry as a consequence of too rapid development and the attempts made to consolidate the position of textile mills and to rationalize the structure of the industry are noted. By 1957, the cotton industry had developed sufficiently, quantitatively at least, to occupy an important position in the economy of Pakistan and to take the first rank in respect to employment, production, and value added by manufacture, among manufacturing industries.

Various aspects of the emergent structure of the industry, including the location of plants, may be noted. Many mills were set up in a hurry without due regard to long-run requirements. As a result, a high proportion of the mills does not have adequate and balanced equipment in order to ensure efficient operation and first quality products. Moreover, since the entrepreneurs were not evenly distributed over the different parts of the country, the regional development of the industry is not well-balanced.

The consequences of the unpreparedness of workers for industrial operations were also important. A high proportion of industrial workers in Pakistan have an agricultural background. They have been slow to acquire adequate skills and a disciplined labor force, fully committed to participation in industrial work, has not yet emerged. The problems of inefficiency, and high rates of absenteeism and labor turnover are still faced by mill managements.

The mill owners, no less than the workers, lacked industrial experience and were unprepared to perform their tasks with competence in the rapid development of the cotton industry. The weaknesses in the management of mills arise from the inexperience of mill owners, from their lack of training in management skills, and also from their authoritarian attitudes to subordinates. These considerations and the paramount influence of the patrimonial system in top management positions have inhibited the development of professional management.

In view of the unpreparedness of workers and managements alike, the Government was called upon to play an important part in the development of the industry. Government measures were designed to assist and encourage the setting up of cotton mills, to increase their productivity, and to stimulate exports of cotton textiles. Legislative measures were passed to promote the development of the trade union movement and to secure better conditions of work for labor, on the one hand, and to ensure adequate textile supplies at fair prices to domestic consumers, on the other.

The main sources of information used in this study are government publications, reports and studies of international organizations such as the United Nations, International Labour Organization, and International Labour Office, studies by individual scholars, periodicals and yearbooks devoted to textiles and to industry and trade, articles in newspapers and their textile supplements, and unpublished Master's theses of the University of Karachi.

Microfilm $2.75; Xerox $9.45. 208 pages.

RIGHTS OF CREDITORS IN LIFE INSURANCE POLICIES

(L. C. Card No. Mic 60-3691)

Stuart Schwarzschild, Ph.D.
University of Pennsylvania, 1960

Supervisor: Dr. Dan M. McGill

The American scene presents the juxtaposition of life insurance as a primary investment medium with an economy based on the extension of credit. This circumstance makes the question of the availability of life insurance for the satisfaction of debt of importance to lenders, borrowers and insureds. Moreover, in nearly all societies, in addition to regular extenders of credit, there are judgment holders who have claims arising from the marital relation, the taxing powers and the liability system. To the relative rights of these and other claimants under the laws of the United States this study is addressed.

The rights of various claimants under the common law is examined from several points of reference. These rights must be considered at two temporal points: before the insurance policy matures and afterwards. Another dichotomy is based on the rights of the insured's creditors and the beneficiary's creditors. A complicating circumstance is that the estate policy, the irrevocable beneficiary policy, and the revocable beneficiary policy all create different interests and remedies.

The courts of the fifty odd American jurisdictions have often arrived at varying positions, and the question arises whether this is due to a difference in the facts or to a difference in the judicial construction. We are concerned with the decisions in the fifty states and the District of Columbia in connection with the remedies by judgment. The evolution of a federal bankruptcy law is an important consideration. Although much of the bankruptcy law is simplified due to its federal status, its application involves the consideration of property rights and interests as determined by the state courts.

Having resolved the rights of the parties in the absence of exemption statutes, the study then moves to the analysis of the development of laws protecting a debtor's property from his creditors. We are especially concerned with laws which specifically protect life insurance policies. This analysis is complicated by the multiplicity of different statutes protecting different types of policies and different amounts of insurance under different circumstances. The applicability of these exemption statutes to tax claims, alimony claims, assignments, bankruptcy, and liability claims is also investigated.

The study of creditor rights would not be complete unless consideration was given to the restraint on alienation known as the spendthrift provision. These provisions are of primary importance in protecting insurance from the beneficiary's creditors although some exemption statutes given similar protection.

The analysis of the development of law relative to creditor rights in life insurance policies considers their underlying rationale as well as their economic and social effects so that a determination may be made as to what extent insurance should be protected. This involves a consideration of the economic and sociological aspects of life insurance and of debtor relief. Recommendations are made in order to simplify the law, to make it more uniform

in all jurisdictions, and to maintain the proper balance between the sanctity of a creditor's claim and the equitable right of a worthy debtor to be relieved, in regard to his life insurance, of the insupportable portion of his obligations. Microfilm $5.45; Xerox $19.35. 426 pages.

CHANGES IN THE MARKETING ORGANIZATION IN SELECTED INDUSTRIES — 1950 TO 1959.

(L. C. Card No. Mic 61-1677)

Robert Eugene Weigand, Ph.D.
University of Illinois, 1961

This study is an analysis of the nature and causes of change in the marketing organization of firms within five major industries during the period 1950 to 1959. The industries selected were the electric and non-electric machinery, fabricated metals, chemicals, and instruments industries. In addition, the scope of the study was limited to the internal organization of firms with a net worth of one million dollars or more.

Three sources of evidence were used. First, an extensive analysis of the management and marketing literature was made. Second, 220 returns from a mailed survey were analyzed to determine the direction and extent of change in the marketing organization structure and the job duties of the chief marketing administrator. Respondents to the survey were asked to furnish similar information for 1950 and 1959. Third, personal interviews were conducted with fifteen non-marketing executives in the industries selected for study.

Analysis of the literature and examination of the survey data indicated a tendency to coordinate activities under a single administrator. The most readily observable evidence consisted of the frequent structuring of line sales and advertising under a marketing specialist. This appears to be one of the long-term phenomena of marketing administration. There were two exceptions, however, to the tendency toward coordination of all marketing activities within a single department. First, in about half the firms with net sales over one hundred million dollars, line sales activities were separated from other marketing activities which were performed by a headquarters staff. Second, the marketing administrator usually had little responsibility for the physical movement functions which are generally considered in the literature to be marketing activities.

In addition to structuring to achieve coordination, the marketing organization became more complex from 1950 to 1959 because of the increasing formalization of marketing activities. Many activities, perhaps long performed, became identifiable parts of the formal marketing organization and were supervised by the chief marketing administrator. There was considerable evidence that marketing research and long-range planning activities were rapidly becoming a formal part of the marketing organization in many firms or at least a part-time duty of the chief marketing administrator.

Growth of sales volume was the most readily identifiable cause of changes in the marketing organizations which were studied. The type of organization that may be used by a small or medium-sized firm (up to one hundred million dollars net sales) was not considered by management to be appropriate for a large firm. In other firms, the broadening of the product line resulted in a more complex marketing organization. Diversification would presumably lead to volume growth, and a few firms were anticipating increased volume by re-structuring the marketing organization. In a few firms respondents indicated that their organizations were more complex in order to cope with the greater variety of identifiable factors which influence marketing decisions.

Changes in the individual occupying the Presidency or in the chief marketing administrator often affected the organization. This finding substantiated elements of the literature which suggest that the structure is frequently adjusted to the capacities of the persons in the system. In addition, it was suggested that the frequent references to the "marketing concept" in the current literature hastened some of the changes.

Finally, there was evidence that managements recognized the importance of organization planning and of adjusting to changes in the business environment. One method of adjustment was through change in the structure of the marketing organization and in the corresponding responsibilities of the chief marketing administrator.

Microfilm $4.45; Xerox $15.75. 347 pages.

AN APPROACH TO ESTIMATING PRODUCTION PERFORMANCE ON NONREPETITIVE WORK

(L. C. Card No. Mic 61-1380)

Albert Eli Wolff, Ph.D.
The University of Texas, 1961

Supervisor: Francis B. May

The study concerns itself with the problem of production performance estimating in the less obviously repetitive case. Since what is or is not repetitive work is a matter of a difference of degree rather than a matter of strict dichotomy, a procedure is developed which permits efficient use of experience data. The procedure is designed to possess maximum logical sense in that it encourages an orderly approach to appraisal of new work in the light of experience accumulated on all work done before with the same staff and facilities.

The procedure involves an application of usual multiple correlation techniques. Total cost is taken as the dependent variable, and the component costs, replaced by scale values, are taken as the independent variables. The scale values utilized for the component costs are taken from a continuum representing degree of complexity of new work relative to complexity of all work done before in the same cost center. The multiple correlation estimating equation provides the basis for estimating performance on new work.

The actual procedure involves preparation of a descriptive array of all work previously done in each cost center. In the array, individual jobs are arranged in descending order of time (cost) involved in completion. By ranking methods, or by the use of a charted, cumulative frequency

distribution, the historical summary is divided into equal parts representing equal steps along a continuum. The key person in each cost center, after reviewing the historical summary and the description of the new work, is asked to "rate" the new work in terms of its complexity relative to the complexity of all work done before. The rating is in the form of a number representing one of the scale steps. These scale values are substituted in the multiple correlation estimating equation to yield the performance estimate.

The study considers the influence of skewness, kurtosis, number of values available, and number of scale steps on the effectiveness of the technique. It suggests that skewness is the most significant characteristic, but that its effects can be overcome to a large degree by scaling from a chart of the costs in each cost center arranged in the form of a cumulative frequency distribution--rather than by scaling from ranks. The "standard error of estimate" decreases as the number of scale steps increases, particularly in the case of evenly spaced independent variables. However, more than five steps tends to complicate the scaling process. With five steps it is possible to scale numerically in translation of such descriptive terms as "average," "slightly above (or below) average," "substantially above (or below) average" in terms of the complexity of the new work relative to the complexity of all work done before in the same cost center.

A minimum of twenty-five values (jobs done) is suggested as a basis for analysis. As more values are accumulated, it is possible to sort out work in a number of mutually exclusive however general categories. By computing an estimating equation for each category or general type of work rather than for all work in a single "basket" classification, the error of estimate is reduced.

Microfilm $2.75; Xerox $3.00. 56 pages.

ECONOMICS, FINANCE

ECONOMIC IMPLICATIONS OF STATE FISCAL DEPENDENCE ON OIL AND NATURAL GAS TAXATION IN TEXAS

(L. C. Card No. Mic 61-1356)

Laurie Dennis Belzung, Ph.D.
The University of Texas, 1961

Supervisor: Dr. Carey C. Thompson

This dissertation is an analysis of the economics involved when a state depends very heavily upon one industrial segment of its economy for a large portion of its tax revenue.

The tax structure in Texas is unique in its extreme dependence upon oil and natural gas production taxes and upon selective sales taxes. This has affected adversely both the industries involved and the state, and there is little prospect that conditions will improve in Texas until its tax structure is revised.

The dissertation begins with a theoretical study of mineral resource taxation, and analyzes each of the arguments that usually is advanced to justify the levying of special taxes on a state's hydrocarbons. Next, it presents a history of Texas mineral resource taxation and compares the state's tax structure with that of the other 49 states in general, and hydrocarbon-producing states specifically. Trends in oil and natural gas demand, production, and tax payments are presented, followed by a study of trends in state spending and the causes of Texas' ever-increasing revenue needs.

An investigation of the economic implications of heavy fiscal dependence on mineral taxation forms the main body of the dissertation. These consequences are analyzed from two viewpoints: their impact on oil and gas industries in the state and the effect such dependence has upon the state itself.

To understand the impact on the oil and gas industries, it was necessary to study their market structures, the elasticities of supply and demand for each of their products, the role of the Texas Railroad Commission, the part played by competing or potentially competitive fuels, and the incidence of oil and gas taxes. There is a discussion of the possible effects of such taxes on the industries concerned.

The economic implications from the state's viewpoint are divided into short-run and long-run considerations. Changes in demand, the effect of out-of-state oil and gas production, and the pricing of Texas oil and gas make up the short-run discussion. The long-run considerations include comparisons and explanations of Texas' diverging patterns of oil and gas tax revenues and state spending needs, the changing oil and gas demand patterns, and the possible effects of heavy taxation on industrial growth generally.

Considerable discussion is devoted to various means of meeting anticipated expanding revenue needs of the state in future years. The possibility of stabilizing severance tax revenue or of levying different types of oil and gas taxes is studied as a partial solution. But the conclusion seems inescapable that eventually Texans and their elected representatives will have to decide upon the levying of one of the major broad-based taxes not employed in the state. For this reason, there is presented in the dissertation a lengthy analysis of the many arguments generally offered both for and against each of the major broad-based taxes on general sales and personal or corporation incomes.

Microfilm $6.15; Xerox $21.85. 482 pages.

THE DEVELOPMENT AND OPERATIONS OF THE EMPLOYEE RETIREMENT SYSTEM OPERATED BY THE CITY OF PHILADELPHIA

(L. C. Card No. Mic 61-2023)

Albert Hatcher Clark, Ph.D.
University of Pennsulvania, 1961

Supervisor: Dr. Dan M. McGill

I. Statement of Problem.

The problem of providing economic security for aged persons has existed in our society for many years. Because of industrialization, urbanization, and the progressive

aging of the population, this problem has become especially acute in the United States within the past few decades. One approach to the solution of this problem is through employee retirement systems. Like many other municipalities, Philadelphia has encountered many problems, both financial and otherwise, in the development and operation of its employee retirement system. Some of these problems remain unsolved even at the present time.

In this study the author attempts to present a comprehensive survey of the employee retirement system operated by the City of Philadelphia. Primary emphasis is upon development and operations. The purposes of the study are to describe and analyze the development of the principal provisions and various operational aspects of the system, to indicate and appraise the problems which have been encountered in the development and the operation of the system, and to evaluate the effects of changes of the system upon the employees, the city administration, and the taxpaying public.

II. Procedure and Methods.

The study is confined to the employee retirement system operated by the City of Philadelphia. Although in past years the City has appropriated funds to privately-operated retirement systems covering certain city employees, these systems are not included in the scope of this study. The study covers the system since its inception in 1915 and also includes pertinent developments of the twenty years preceding its establishment.

Both primary and secondary sources are used in this study. Data have been obtained by personal interviews with various city administrators and officials, and other persons who are, and have been, concerned with the city employee retirement system. The bulk of the data used in the study have been drawn from state legislative acts, proceedings of the state legislature, state court cases, city ordinances, the city charter, various city reports, city solicitor opinions, reports of actuarial examination of the retirement system, rules and regulations of the system, and proceedings of the governing board of the system.

The developments of the system are surveyed chronologically in Chapter Two. This outline is presented in order to give a broad perspective of the system at the outset. In Chapters Three through Ten the presentation is functional with the development and operations of the various aspects of the system being treated. These functional aspects are the following: administration, employees covered, benefits, sources of funds, funding, and financial operations. The final chapter is devoted to a summary of these functional aspects, and a critique of the entire retirement system.

III. Conclusion.

Both administrative and financial problems have been encountered by Philadelphia's city-operated retirement system, and in many respects the system has failed to keep abreast of changing situations and developments. Many of the shortcomings of the system were corrected by the Municipal Retirement System Ordinance of 1956 and changes that have taken place since 1957. Most of these changes were long overdue, and although it is obvious that they have not made the system perfect, they were steps in the right direction.

The most serious deficiency which has plagued the system since its establishment, however, still remains. Reference is made to the inadequate funding of the liabilities of the system. Under the present financing program there is no guarantee that the financial condition of the system will improve in the future, and there are indications that the condition will grow worse.

Microfilm $2.75; Xerox $9.45. 209 pages.

FEDERAL REGULATION OF BANK HOLDING COMPANIES

(L. C. Card No. Mic 61-1360)

Lawrence Lee Crum, Ph.D.
The University of Texas, 1961

Supervisor: Charles L. Prather

Group banking, the control of separately incorporated banks by a bank holding company, first appeared in the United States around 1900, principally as an outgrowth of chain banking, the control of multiple banking units by an individual or individuals. Business concentration, restrictions on branch banking, and the speculative spirit of the latter 1920's brought holding-company banking to its greatest prominence during 1927-1931. Basic limitations of holding-company banking, such as difficulty of uniform examination and possibilities for improper intra-system transactions, accentuated by some notable failures during the early 1930's, prompted efforts toward bank-holding-company regulation. Federal regulation was ultimately achieved in the Banking Act of 1933. Conditions for obtaining a stock-voting permit were the vehicle of regulation. The voluntary nature of the voting-permit regulation, coupled with the narrow definition of "bank holding company" employed caused the 1933 federal regulation to have a minimal effect on group-banking development.

In 1938 there began a lengthy struggle of various interests to secure more comprehensive federal regulation of bank holding companies. The principal purpose was to prevent undue concentration of control over banking facilities. Continued growth of the Transamerica system and a few other large bank-holding systems motivated independent bankers' associations to provide the most persistent agitation for new regulation. The federal banking agencies promoted the enactment of more moderate regulatory legislation than that proposed by independent banking interests. But certain provisions in the emerging Bank Holding Company Act of 1956, e.g., the restrictions on "horizontal" and "upstream" lending in group systems clearly reflect the aggressive, sometimes irrational influences which expedited enactment of the legislation.

The Bank Holding Company Act requires the Board of Governors of the Federal Reserve System to pass upon group-banking expansion. Despite some limitations, the regulation appears to be an equitable complement to general antitrust legislation. But in order to afford impartial regulation, it is necessary, as the Board has recommended, for Congress to eliminate certain exemptions

from the Act and to extend coverage to one-bank holding companies.

The requirement of divestment by bank holding companies of nonbanking interests is the feature of the 1956 bank-holding Act which has drawn the most criticism. It is questionable whether avoidance of certain potential evils, the purpose of the divestment feature, is sufficient justification for the adjustments which have been required. Under the "potential evils" doctrine, the Board of Governors has established quantitative and qualitative tests which have helped make its decisions on applications for exemption from divestment (under Section 4 (c) (6) of the Act) easier than those regarding proposed group-banking expansion.

The Board of Governors must consider several statutory criteria in passing upon applications for bank-holding-company formation or expansion, most important of which is whether the size or extent of the holding-company system would be consistent with adequate and sound banking, the public interest, and preservation of competition in the banking field. Congressional clarification of the meaning of "preservation of competition," of the relationship between this element and certain other elements of the criteria, and of the general purposes of controlling group-banking expansion would facilitate more uniform administration of the 1956 Act.

The Federal Bank Holding Company Act has stimulated legislative action on multiple-location banking in several states. Some conflicts of jurisdiction between federal and state laws will likely arise. These, together with problems of administrative discretion and of ambiguities in the federal Act, will deter some bank-holding-company formation during the formative period of the legislation, but in the long run, the concrete principles and policies laid down under the Act should encourage sound group-banking development. Microfilm $4.80; Xerox $17.10. 376 pages.

CORPORATE FINANCIAL REPORTING IN PAKISTAN

(L. C. Card No. Mic 61-2037)

Abul Hasnat, Ph.D.
University of Pennsylvania, 1961

Supervisor: Professor Rufus Wixon

The financial reports of companies, for which accounting is responsible, are the principal means, and probably the most important, by which investors and others having an interest endeavor to appraise the position and the accomplishments of companies. Accordingly, it is essential that the information so presented be clear and meaningful, truthful, and realistic.

The financial reports issued by companies in Pakistan show clearly that the management is not eager to acquaint the parties at interest with the results of the business. For one thing, few companies incorporate in their annual reports textual material commenting upon the financial results. For another, the treatment of financial items has not always been such as to help outsiders.

While in general the financial statements, as included in corporate annual reports disclose adequate business statistics, the presentation is so terse, formal and forbidding that the statements lose most of their interpretative value, especially to those who have little knowledge of accounting procedure. The accountants do not seem to have realized that the usefulness of statements depends to a large degree upon the manner of presentation – classification, sequence, caption etc. – as well as upon the nature and adequacy of underlying data.

Stress seems to be laid by accountants upon technique and precise columnar tabulations rather than upon clear-cut explanation. In general there appears to be a failure to recognize the fact that the financial statements are not an end in themselves but are rather a means to an end, and that such statements are worse than useless unless they serve the purposes for which they are intended.

The account form of income statement invariably employed in Pakistan has serious drawbacks. It is too technical to be readily understood and it fails to provide means for displaying essential figures in a clear-cut manner. In the construction of the balance sheet the accountant seems to be guided solely by the debit or credit balance of the relevant items appearing therein, with little attention being given to whether or not a meaningful presentation results. As a consequence the resulting statement is much too technical in character to be read with facility by those interested in the statement of financial condition.

There appears to be a tendency to employ in the financial statements captions and titles that are identical with the account titles used in the ledger. This, too, leads to confusion and misunderstanding on the part of individuals examining the statement.

The responsibility for the unsatisfactory corporate reporting in Pakistan by no means rests solely on the shoulders of accountants. The fault lies also in the structure of a Companies Act framed by lawyers not adequately grounded in accounting and finance. Although the Act does not prescribe a form of income statement it does prescribe a balance sheet form and requires that the balance sheet data be set forth in this form or as near to it as possible. This standardization of form at least to some degree has hindered experimentation and improvement in statement presentation. Perhaps a policy of insistence upon adequate disclosure and encouraging flexibility would free directors and accountants from the shackles of standardization, and encourage the profession to develop a consistent framework of accounting and reporting standards which could be amended and added to from time to time as conditions required. The test should be "Is this in accordance with sound accounting and reporting standards?" not "Is this in accordance with the statute?" This seems to be the position in the United States, and it seems to work.

Microfilm $2.75; Xerox $8.00. 175 pages.

THE USE OF INFORMERS' REWARDS IN FEDERAL TAX ADMINISTRATION

(L. C. Card No. Mic 61-1320)

Bernard Paul Herber, Ph.D.
University of Washington, 1960

Chairman: Philip W. Cartwright

Although the federal government employs many techniques to detect tax evasion, perhaps none is more

questionable to those cognizant of the various methods used than the payment of rewards to tax informers. It may be legitimately asked whether the federal tax informer program is a desirable "means" of tax enforcement in a democratic society with sufficient governmental stability to apply other "less irritating" enforcement devices. The purpose of this dissertation is to investigate and evaluate, in economic fashion, the tax informer program.

The methodology of the dissertation follows the inductive technique in gathering data relevant to the above question. These data include analyses of the historical background of informers' rewards and, also, the over-all contemporary use of informers' rewards by the federal government.

Moreover, the legislative and statutory development of the federal tax informer program is presented along with the judicial interpretation and administrative application of these statutes. Quantitative data and economic theory assist in reaching the conclusions of the dissertation. Major sources of research information include Congressional, Treasury Department, and Justice Department documents, federal court cases, and personal letters. The minor sources include books and periodicals.

The term "tax equality" as used herein connotes the idea of equality in tax enforcement. This provides the environmental background within which rewards to federal tax informers may be analyzed as a specific tax enforcement device.

Historically, the origins of the tax informer concept derive from ancient Greece and Rome. Mediaeval and post-mediaeval Europe utilized tax informers and some American state governments used them in property tax enforcement from approximately 1870-1920. Many federal government divisions presently offer informers' rewards for help in law enforcement. Consequently, the informers' rewards concept is not new, nor is it confined to tax enforcement.

The first federal tax informer law was passed in 1791. The period 1861-1874 saw intensive statutory activity. In 1867, the basis of the present "general informer's provision" in tax law was enacted. There has been little statutory action since 1874, with the most important occurring in 1949.

Judicial interpretation and administrative application of federal tax informer law has resulted in many significant court decisions, Treasury decisions, and opinions of Attorneys General. For example, thirteen decisions of the Treasury Department administered the basic statute from 1872-1959. Quantitatively, the government paid rewards totaling $5,880,965 to tax informers with an average reward of $1,142 between 1924-1958.

Some tax informers provide information from motivations such as revenge or patriotism and do not expect monetary compensation while others do expect rewards. The (price) elasticity of supply of the latter is inelastic in the short run, but becomes more elastic in the long run as certain parameters change. The long run allows sufficient time, (1) to eliminate maximum reward limits, (2) to make rewards compulsory, (3) to publicize the rewards program, and (4) to attain greater "respect" for tax informers. These changes would increase the supply elasticity and, also, the supply itself of tax informers.

The tax informer market structure approximates a bilateral monopoly with one seller of information (the informer) and one buyer (the government). The balance of economic power is on the demand or buying side because the informer has no legal alternative use for his information.

The tax equality "objective" of the rewards program is legitimate. Thus, any conclusion regarding justification of the program must consider informers' rewards as an "acceptable means" to a desired objective. Several negative arguments attack the informers' rewards "means" of tax enforcement. On balance, the positive arguments which defend the program successfully answer the negative arguments. It is concluded that the federal tax informer program is an acceptable "means" when used moderately and prudently as at the present time.

Several possible revisions in the program are considered, but only two are desirable. These are, first, a well planned publicity program intended to increase public knowledge of the rewards program in certain specialized tax areas and, secondly, the establishment of an absolute minimum reward limit.

Microfilm $2.80; Xerox $9.90. 216 pages.

AN ANALYSIS OF THE FINANCIAL PROBLEMS AND PRACTICES OF 153 CLOSELY HELD COMPANIES WHICH OFFERED SECURITIES TO THE PUBLIC IN 1957

(L. C. Card No. Mic 61-1925)

Robert Lawrence Johnson, Ph.D.
State University of Iowa, 1961

Chairman: Associate Professor Robert M. Soldofsky

This study analyzes 153 companies all of which had been closely held until 1957 when initial public offerings of securities were made. Two questions which are of central importance throughout the study are: (1) What conditions are typically present in a company prior to the successful initial public distribution of securities? (2) What factors should be considered in the determination of the offering price? An analysis is made of many other problems faced by closely held firms at the time they initially offer securities publicly. These other problems are associated with: (1) capital structure strategy, (2) short-term credit, (3) the maintenance of control, and (4) dividend policies.

About one-fourth to one-third of the companies studied were using more long-term debt and preferred stock prior to the 1957 offerings than appeared to be financially safe. Very few of the companies studied had obtained credit with final maturities of more than ten years. Most closely held firms grow primarily with funds provided by the retention of earnings. Many of the closely held firms studied financed part of their permanent assets with temporary sources of funds.

Managers of closely held firms are often reluctant to give up effective control even though their firms are "going public." Methods used (effectively in some cases) to help maintain control include: (1) financing with debt or non-voting preferred stock, (2) publicly offering only non-voting common stock and, (3) issuing large amounts of voting stock to the management group for intangible assets.

Most of the firms studied paid no dividends as long as they were closely held. They frequently began to pay dividends at the time of their initial public distribution of securities. Sales of stock at capital gains by the major stockholders and payments of officers' and directors' salaries were analyzed as tax advantageous alternatives to dividend payments.

Many of the companies which attempted distributions of securities by best efforts underwriting or without investment banking services did not complete their offerings. An analysis was made comparing by company size, company age, offering size, industrial classification, and financial condition those companies which obtained firm commitment underwriting with those which did not. Costs of distribution were also analyzed.

A secondary market is generally formed for issues of common stock of $500,000 or more regardless of whether firm commitment or best efforts underwriting is used. For smaller issues, there is a better chance of a secondary market being formed when firm commitment underwriting is used than when best efforts underwriting is used.

In the majority of cases, price-earnings ratios computed on the offering prices are fairly close to (although generally a little lower than) price-earnings ratios of comparable companies at the same time.

For companies offering common stock and for which earnings records were available, the influences of the following variables on offering price determination were analyzed: leverage, current ratios, growth trends, recent changes in earnings, rates of return on common stockholders' equity, book values, offering sizes, and company sizes. Subsequent market performance was used as a method of determining the appropriateness of using, or not using, each of the variables.

A less exhaustive analysis of offering price determination was made in the cases of offerings of common stock from companies which had no records of earnings, of offerings of bonds or preferred stock together with common stock, and of offerings of bonds or preferred stock separately. Microfilm $7.50; Xerox $26.55. 590 pages.

CONSUMPTION PATTERNS IN UNDERDEVELOPED COUNTRIES

(L. C. Card No. Mic 60-3594)

Taufiq Mohammad Khan, Ph.D.
University of Pennsylvania, 1960

Supervisor: Irwin Friend

The main objectives of the study were to analyze the patterns of consumption in underdeveloped countries in order to find similarities and differences in consumer behavior within these countries and to compare the results with those of the developed countries. The patterns of consumption were primarily measured from family budget data in terms of the income and expenditure elasticities of demand. These elasticities were derived by fitting the demand functions of the following form:

$$(1)\quad \log Y_i = a_i + b_i \log X_1,$$

$$(2)\quad \log Y_i = a_i + b_{1i} \log X_1 + b_{2i} \log X_2,$$

$$(3)\quad \log \frac{Y_i}{X_2} = a_i + b_i \log \frac{X_1}{X_2},$$

where Y represents expenditure on ith commodity, X_1 stands for total income or in some cases total expenditure, X_2 for family size measured in number of persons and a_i, b_{1i}, b_{2i} are constants estimated by the method of least squares.

In spite of certain local and institutional differences in underdeveloped countries, there was a marked similarity in the consumption patterns at least with respect to the major categories of expenditures. A generalization of the observed results led to the conclusion that the elasticity of food with respect to total expenditure was in the neighborhood of 0.80 in underdeveloped countries compared to 0.60 in the developed countries. As regards the various sub-categories of food, the elasticity for cereals and pulses was found to be about 0.40 which is twice as much as in the developed countries. The elasticity of animal foods was found to be higher than one in many underdeveloped countries as against an elasticity of less than one in the rich countries. The elasticities for sugar, fruits and vegetables, milk and fats were found to be about 0.75, 0.90 and 0.90, respectively in the underdeveloped countries. The elasticities for housing showed substantial differences from country to country and class to class. The elasticities for fuel and light were less than one for all countries. The elasticities for clothing showed a great similarity in the underdeveloped countries. These were found to be either very close to one or greater than one. The results were similar to those in the developed countries. Like the developed countries, the elasticities for miscellaneous goods and services were uniformly greater than one in underdeveloped countries. The elasticities for education and personal services were greater than one, whereas those for medical expenditure and tobacco and drinks showed a range of 0.62 to 1.98 and 0.50 to 2.50.

The partial elasticities with respect to famiiy size were obtained by the use of equation (2). The elasticity of total expenditure with respect to family size was found to be 0.50. The value of this elasticity for food was 0.30 which was similar to that for the developed countries. While the family size exercised an important influence on total consumption and food expenditures, the effects on other categories of consumption were erratic. A high correlation was found between income and family size.

The resulting elasticities from the regression of per capita expenditure on per capita income were lower for food, housing, fuel and light and higher for clothing and higher for miscellaneous items when compared to the elasticities derived from the double-log function fitted to the data of family income and expenditures.

An attempt was made to test Professor Friedman's permanent income hypothesis. Since the transitory factors play an insignificant role in producing income differences in underdeveloped countries, it would be expected that the income elasticities of consumption in these countries were very close to one. The results of the test were

inconclusive. These elasticities for underdeveloped countries were generally greater than those for the developed countries and, to this extent, they support the permanent income hypothesis. On the other hand, only in four cases out of 27 did these elasticities show a value of 0.95 or greater. Microfilm $3.10; Xerox $10.80. 239 pages.

BRITISH AND AMERICAN SYSTEMS OF INCOME TAX WITHHOLDING

(L. C. Card No. Mic 61-1412)

Alan Page Murray, Ph.D.
Columbia University, 1961

Income tax withholding from wage and salary receipts is an accepted feature of modern life in both the United Kingdom and the United States. The systems have acknowledged administrative advantages; their economic significance is the subject of this Dissertation.

Ten criteria of current payment collection at source are introduced to provide a framework for the analysis. The initial criterion formulates preconditions for the successful implementation of wage withholding. The second criterion, one of four equity criteria, advances the familiar principle of the equal treatment of equals, as related to the present context. The third criterion establishes the companion principle of progressive tax burdens among unequals. The relation between tax withdrawals and income receipts is governed by the fourth criterion. The final equity criterion states that wage and salary withholding should be an integral part of a general plan for current payment tax collection. The important sixth criterion stipulates that the collection apparatus should express the built-in flexibility potential of the tax structure to the fullest extent possible. The four remaining criteria warn of disadvantages to be minimized, in the form of rigidities that impair discretionary fiscal policy, excessive administrative cost, adverse incentive effects, or a reduction in the level of tax consciousness.

The British Pay As You Earn system is examined; its place within the tax structure is outlined. The events preceding its inauguration in 1944 are sketched. The operation of the system is described in detail. The system in both conception and practice is then carefully evaluated in the light of the individual criteria. The withholding system of the United States is discussed in a similar manner.

Pay As You Earn embodies elements not found in its American counterpart. In Britain, specific tax withdrawals are based upon the cumulative earnings of the tax year, taken in conjunction with a careful estimate of individual reliefs and allowances. The graduated tax rate scale of the Income Tax is employed. The over-all result is accurate tax collection; five out of six wage earners fulfill their precise tax obligations through the periodic withdrawals. This performance stands in marked contrast to the achievements of the American withholding procedure. The latter is designed for provisional tax collection only. Tax withdrawals are computed on the basis of a flat rate of tax and a standardized exemption schedule. Moreover, each payroll period is considered in isolation. Few American wage earners are able to meet their precise obligations through the mechanism of the withholding tables. Over thirty-five million individuals experience overwithholding every year.

Compared within the framework of the criteria, neither system emerges as clearly superior. Pay As You Earn is more efficient in preserving equal treatment for equals. It imposes more steeply progressive tax burdens among unequals, a fact not entirely offset by the American estimated tax procedure. Perhaps the major advantage of Pay As You Earn lies in its greater built-in flexibility. For its part, the withholding system is less complex and therefore less costly to administer. It is also part of a comprehensive design aimed at universal current payment. There is little difference between the two systems with respect to the other criteria.

Built-in flexibility considerations are emphasized. The tax collection system is the practical instrument through which the potential inherent in the tax law is realized. Pay As You Earn's cumulative feature, as well as its graduated rate scale, is shown to be a significant advantage. Extensive overwithholding is symptomatic of the withholding system's failure to mobilize the maximum response to economic fluctuations. These considerations form the basis for the concluding chapter of the Dissertation, where it is recommended that the withholding system of the United States be modified to include the cumulative principle. Microfilm $5.00; Xerox $17.55. 389 pages.

EGYPTIAN INCOME TAXATION OF NONRESIDENT ALIENS AND FOREIGN CORPORATIONS AND ITS EFFECTS ON EGYPTIAN ECONOMIC GROWTH

(L. C. Card No. Mic 60-6318)

Abdel Moniem Aly Abdel Rahman, Ph.D.
Indiana University, 1960

The study is an attempt to analyze the legal, administrative, and policy problems involved in Egyptian taxation of nonresident aliens and foreign corporations and the impact of such taxation on the economic growth of Egypt. Like other underdeveloped countries, Egypt seeks to attract foreign investment in order to break the vicious circle of poverty that hinders capital accumulation. The effects of taxation on foreign investment are recognized as important in designing the country's economic growth policy.

Egypt has already taken steps to improve her investment climate. Prospective investors are given the assurance of remittability of capital and income, as well as income tax exemption of investment considered vital to the development and support of the national economy.

However, the current Egyptian income tax laws are to a large extent an Arabic translation of French legislation before the latter was amended in 1948. The tax policy brought about by these laws is not designed for the promotion of economic development. As a result, there is no well-integrated policy based on considerations of the welfare of the country.

The study indicates that Egypt taxes nonresident aliens and foreign corporations according to the principle of "source of income." Nonresident aliens are taxed only on that portion of their income derived from sources within

Egypt. Foreign corporations are subject to Egyptian taxation to the extent of their profits realized through a permanent establishment within the country. The country does not discriminate to the prejudice of foreign corporations; the concept of "permanent establishment" as developed by the Egyptian judicial divisions is consistent with the approach that has been developed in international tax treaties. This test offers a considerable degree of predictability and equity to international business, especially as compared with the "business connection" test used by India and Pakistan.

The role of tax administration in stimulating international capital flow has not received much attention. On the contrary, because of conflicting, inconsistent, and overlapping rules of allocation, Egypt practices extraterritorial taxation, which largely offsets the favorable effects of a given tax policy. No matter how well the tax system is designed to promote the ends of economic growth, these ends will not be achieved unless tax administration is efficient. The greater the degree of uncertainty due to the instability of tax codification and its interpretation, the higher the cost of carrying on business in Egypt.

Egypt, along with other underdeveloped countries, has reluctantly entered into international tax treaties. The adoption of tax treaties has not been premised on the desire to promote equity or effective tax administration in the area of international income. Instead, it has been based on the desire to stimulate the flow of international capital necessary for economic development. Negotiation of the tax treaties based on reciprocal tax exemption reflects the bargaining feature of these agreements. However, negotiation should not be so much a matter of bargaining for special concessions as of seeking mutually advantageous reforms in tax law and administration.

Underdeveloped countries rely heavily on tax models developed as a basis for negotiation among advanced countries. These models are the least appropriate basis on which Egypt should establish her tax treaties program. Tax treaties should not be directed toward decreasing the tax liability of the residents of underdeveloped countries on their investments abroad--they should aim at deterring capital flight as well as inducing capital flow.

Tax exemption is now having its day in underdeveloped countries as a fiscal device aimed at increasing investment and achieving a better balance of payments. In a country like Egypt, where the primary reliance for revenue is placed on indirect taxation and public monopolies, income tax cannot play a significant role in business decisions. Because of a world-wide adoption of tax exemption and because of the limited capital available relative to demand, tax exemption per se cannot differentiate favorably the climate of private investment in a given country. Any further deduction in the already low tax burden may provide a "tax exemption trap" and contribute only a needless loss of tax revenue, since the benefit is given to firms that would have been organized without the exemption.

Microfilm $2.95; Xerox $10.35. 227 pages.

THE STOCK DIVIDEND — AN ANALYSIS OF ITS CONCEPTS, ITS INFLUENCE ON STOCK PRICES AND ITS USES BY CORPORATE MANAGEMENTS.

(L. C. Card No. Mic 61-1799)

Marvin Richard Sussman, Ph.D.
University of Michigan, 1961

The purpose of this study is to investigate three basic questions which pertain to stock dividends: (1) What is the conceptual nature of a stock dividend? (2) How do stock dividends influence stock prices? (3) Why are stock dividends issued by corporate managements?

As a basis for considering the nature of a stock dividend, concepts expressed by authorities in the fiduciary, the tax, the accounting, and the regulatory areas were examined. In almost every instance, these authorities considered stock dividends to be merely additional evidences of existing ownership interests. This author agrees that this approach is the only logically acceptable one.

The influence of stock dividends on stock prices was investigated by a statistical study of eighty-seven stock dividends issued in 1958 by companies listed on the New York Stock Exchange. Adjustments were made for factors which might have had a general influence on stock prices, as well as for those factors which might have specifically influenced the stock prices of the companies being studied.

No clearly representative result was produced by this study. Stock dividends appeared to influence the share prices of each company in varying degrees, as well as in different directions. However, there was an indication that relatively small stock dividends did have a very general tendency to enhance slightly the entire market value of the distributing corporation's shares.

Managements' objectives in issuing stock dividends were examined by means of a questionnaire which was sent to officers of one hundred and twenty corporations. Of the eighty-one replies received, approximately seventy-six percent indicated that their primary objective was to conserve cash. In spite of the extreme emphasis upon this objective, as well as the apparent existence of many other goals, this author concluded that the factor of stockholder relations was the primary basic consideration in issuing stock dividends. Stock dividends were issued to maintain existing stockholder relations, or to improve them.

Microfilm $3.20; Xerox $11.05. 245 pages.

ECONOMICS, THEORY

THE AGGREGATION PROBLEM FOR SYSTEMS OF INTERDEPENDENT EQUATIONS

(L. C. Card No. Mic 61-102)

John Shih-yao Chiu, Ph.D.
University of Illinois, 1960

The thesis is an attempt to deal with certain aspects of the problem of aggregation, that is, of the relationship between macro- and micro-economic theory. The emphasis

of the thesis is on the methodological implications concerning economic models as well as on the techniques and procedures of aggregation. The nature of the aggregation problem is explained by three different views held by Hurwicz, Orcutt, and Theil. Two approaches, the consistency approach versus the analogy approach, are alternately followed to perform three types of aggregation, over individuals, commodities, and time periods. The last type, aggregation over time periods, does not receive much attention in the thesis because the emphasis is on simultaneous interdependence, not dynamics.

Single-equation macro-models are used to show step-by-step the three types of single aggregation and multiple aggregation. Bivariate functions are first chosen for discussion to avoid the complications of cross effects which are shown in multivariate functions. The contradictions between the corresponding micro- and macro-relations are explained and the stringent conditions necessary for the absence of contradictions are enumerated.

The multiple aggregations and exactly how they are done are explained in considerable detail. Many new terminologies are developed for two purposes: first, to help to explain the procedures of multiple aggregation; and second, to form a series of intermediate concepts as the successive steps leading toward the final results.

The last single-equation macro-model is based on the aggregation of a system of interdependent micro-equations to show the effect of emulation on the aggregate marginal propensity to consume. This leads into the macro-models of more than one equation. The process of aggregating structural micro-equations directly into structural macro-equations is shown first. It is followed by the aggregation of structural and reduced-form micro-models into corresponding macro-models, first by the consistency approach and then by the analogy approach. This involves the conditions of identification which are examined in the context of aggregation.

The theoretical and econometric implications of the aggregation problem for systems of interdependent equations are exposed. The consistency approach to macro-models of more than one equation is abandoned, for it is inapplicable in these cases.

Finally, the conclusion points out the necessity of aggregation and the nature of the problem as theoretical specification errors arise in both macro- and micro-theory. The criterion of "perfect" aggregation as advocated by Theil is criticised and the direction of possible improvement is proposed.

Microfilm $2.75; Xerox $6.80. 142 pages.

A CRITICAL EVALUATION OF THE WAGE THEORIES AND WAGE POLICIES OF THE CHICAGO SCHOOL

(L. C. Card No. Mic 60-6286)

Louis Arnold Dow, Ph.D.
Indiana University, 1960

The Chicago School has advanced their own version of the marginal productivity theory of wages--the "competitive as if thesis." The members of the School are in close agreement that competitive conditions dominate the demand side of the wage bargain, though a cleavage exists on the supply side. Some, such as Henry C. Simons and his followers, argue that unions have complete and strict control over supply, while others, such as Milton Friedman and G. J. Stigler, believe that union control is rather unimportant. Thus, Simons and his close followers conclude that union wage policies result in a misallocation of resources; and Friedman and Stigler conclude that, aside from a few exceptions, unions have had little impact on resource allocation. Both branches of the School agree, however, that when union monopoly does exist it distorts resource allocation and should have the antitrust laws applied to it.

This study evaluates the members' views as regards the demand and supply sides of the wage bargain, and also their social ethic. The major conclusions on the demand side are: Their version of competition involves such very long-run variables that the formal model of pure competition cannot be used without making additional assumptions; these assumptions, despite the School's methodology that theory is to be judged in terms of the "realism" of its predictions and not its assumptions, must be "realistic"; that with reference to the type of predictive accuracy they have in mind, any of a number of alternative models (including pure monopoly) will suffice; and that under conditions of pure competition with uncertainty there is the possibility of a shock effect.

The chapter on the supply side concludes that the short-run – long-run dichotomy applicable to workers does not coincide with the short-run – long-run dichotomy applicable to employers. Thus the wage structure posited by the "competitive as if thesis" may well be indeterminant and does not provide a yardstick against which a union-influenced structure can be compared. Also it is concluded that the concept of an equilibrium of net advantages accepted by the School requires the additional assumption of much worker knowledge as regards numerous things if the net-advantage equilibrium is to emerge.

The School's models of trade-union policies are then examined, with the conclusion that Simons' models are internally inconsistent and do not match reality too well. Friedman's and Stigler's models are both more logically consistent and realistic, though it is argued that Friedman perhaps overemphasizes the impact of industrial unions on relative wages.

The concluding chapter discusses the School's liberalist ethic and draws the major conclusion that these economists have advanced the goal of maximum individual freedom but no program for achieving it that does not assume that interpersonal comparisons of "freedom gains and losses" can be made. However, they do not explain the process by which these comparisons can be made and thus do not provide a firm basis for policy proposals.

Microfilm $3.30; Xerox $11.50. 254 pages.

A TAXONOMIC STUDY OF CERTAIN MODELS OF ECONOMIC GROWTH

(L. C. Card No. Mic 61-1442)

Albert Albrecht Hirsch, Ph.D.
Duke University, 1960

Supervisor: Charles E. Ferguson

It is contended in this study that if formal models of growth in aggregate income are grouped into two classifications based on certain fundamental assumptions, each type of model has properties that are markedly different from those of the other type. These properties include the way in which the endogenous growth mechanism works, the manner in which "non-economic" variables affect growth, and the theoretical function fulfilled by the model.

R. F. Harrod's "Essay in Dynamic Theory," published in 1939, presents the prototype of the first kind of model, its fundamental condition being continuous equality of desired saving and investment with capital (if not also labor) fully utilized. The Samuelson-Hansen "multiplier-accelerator" interaction model, is--insofar as growth is obtained--the prototype of the demand-generated model. The latter involves one or more lags in the flow of income, so that desired saving and investment are generally not equal.

When the Harrod and Samuelson-Hansen models are rationalized as growth models, each is found to be unsatisfactory, but for different reasons. Alternative or additional assumptions are therefore introduced. The properties of the revised models are then studied and generalizations are made from special cases.

Harrod's model is modified by substituting the Cobb-Douglas production function for the alternative functions implicit in the use of the linear accelerator in a long-run growth model. This modification also facilitates the introduction of some mechanism for equilibrating desired saving and investment. Such mechanisms are suggested in the growth models of professors Solow and Kaldor. This study invokes certain of their assumptions, but extends or modifies their models in such ways that alternative assumptions concerning saving and investment behavior, population growth, and technological progress can be studied for their comparative effects on the rate of growth. It is shown that whether the Solow or Kaldor assumptions for equilibrating desired saving and investment are used, the long-run behavior of output is virtually the same. In particular, if innovations are assumed to be neutral, the rate of growth of output is in both cases a function only of the rates of population growth and technological progress in the long run; whereas under non-neutral innovations, the rate of saving and investment is also effective in the long run and the rate of growth tends to rise.

Variants of the Samuelson-Hansen model, which yield difference equations in income of the second or higher order, depending on assumed lags, result in rapidly accelerating growth if income increases monotonically. To obtain steady growth which is also plausibly moderate requires modifying assumptions other than those pertaining to lags. One way is to introduce resource or monetary constraints. On the other hand, the demand-stimulating forces of population growth and innovations can, under restricted conditions, be assumed to generate rising "autonomous" expenditures, thus obtaining growth from an otherwise damped model. Another way is to replace the ordinary accelerator with a "weaker" form of the relation. Under any of these modifications, however, the path of output is sensitive to changes in particular assumptions, parameter values, or random disturbances, tending easily to accelerate upward or become cyclical. Contrary to the case of long-run models, the production function and the character of inventions play no explicit role.

The tendency of multiplier-accelerator models with plausible parameter values to yield cycles leads to consideration of mechanisms of growth with cycles, which is undertaken briefly.

If a long-run (Harrod-type) model has any explanatory validity, it is concluded, this lies in showing how certain "non-economic" variables impinge upon the rate of economic growth. The role of a demand-generated model must be more restricted, namely to establish under what conditions steady or cyclical growth is possible.

Microfilm $2.95; Xerox $10.35. 228 pages.

A SHORT-RUN THEORY OF REAL GROSS NATIONAL PRODUCT

(L. C. Card No. Mic 61-1665)

Ronald Eugene Simmons, Ph.D.
University of Illinois, 1961

Output markets, factor-input markets, and money markets constitute a national economy. In this dissertation the writer makes what is for him a first attempt at increasing the generality of a Keynesian-type model by presenting a theory of real gross national product which contains elements from all three types of markets.

The theory presented may be viewed as a set of modifications to the traditional Keynesian model. The major modifications are: (1) the price level is a variable and is not assumed constant although the aggregate output of the economy is below the full-employment level; (2) there are four types of income: wages, salaries, dividends, and profits whereas the Keynesian model gives explicit attention only to the income flow going to business firms; (3) added attention is given to the ability of business firms to finance investment from internally generated funds; and (4) the interest rate is not a variable but is assumed constant.

The model, which consists of twenty-one equations, twenty-one variables, and twenty-one parameters, yields a polynomial of degree six in *Y, real gross national product. Initial values are arbitrarily assigned to those parameters for which empirical estimates are unavailable. The initial value of each of the remaining twelve parameters is altered four times with all other parameters retaining their initial values. The effects upon real gross national product of the alterations are evaluated by a high-speed electronic computer. The five evaluations and the five associated parameter values for each of the twelve parameters are plotted on logarithmic scales so that the slope of a chord connecting any two points on the surface of a graph is a measure of the arc elasticity of real gross national product with respect to the particular parameter.

For the range of parameter values covered, the real value of gross national product increases as the values of the following parameters increase: B, the stock of internally generated funds owned by firms and provided by accumulated depreciation allowances; b, the marginal propensity to consume wage income; c, the marginal propensity to consume salary income; d, the marginal propensity to consume dividend income; h, the marginal propensity to pay dividends; U, the stock of funds owned by firms and provided by accumulated retained profits; and v, autonomous dividends paid by firms to capitalist households. Real gross national product is relatively inelastic with respect to each of these parameters over the intervals considered, but the elasticity is greater with respect to the marginal consumption propensities, b, c, and d and autonomous dividends, v, than with respect to B, h, and U.

Conversely, the real value of gross national product decreases as the values of the following parameters increase: F, the stock of debt owed by firms to financial institutions; $\overline{H}$, the supply of salary labor; j, the market rate of interest; m, the mark-up coefficient used by firms in setting price; and $\overline{w}$, the wage rate per hour. Real gross national product is inelastic with respect to each of the parameters F, $\overline{H}$, j, m, and $\overline{w}$, but numerically the elasticity with respect to m and $\overline{w}$ is larger than with respect to F, $\overline{H}$, and j.

The major policy implications for a government economic sector which may be superimposed upon the private sector in order to increase the latter's short-run output is that the particular economic policies of government should operate through goods and factor markets. Government policies designed to increase B, U, and j, policies which are directly applied to money markets, would not have a significant positive effect upon real gross national product. Microfilm $2.75; Xerox $3.60. 61 pages.

BARGAINING EXPERIMENTS: AN EXPLORATORY STUDY.

(L. C. Card No. Mic 60-5059)

David Harold Stern, Ph.D.
Princeton University, 1960

Three experiments were conducted which made possible the testing of a variety of hypotheses about bargaining behavior; the study is called exploratory because it is the methods and techniques of experimentation in economics, rather than the results themselves, which are of primary interest.

Underlying the experiments is a game-theoretic bargaining model which resembles that of John Nash ("The Bargaining Problem," Econometrica, XVIII (1950), pp. 155-162), except that in the present model bargaining opportunities are defined in terms of money or "game-money" payoffs instead of the players' utility functions. The relationship of this model to utility theory is discussed.

The abstract model is realized by means of "bargaining diagrams," after the manner of Jeremy Stone ("An Experiment in Bargaining Games," Econometrica, XXVI (1958), pp. 286-296). In the present experiments a bargaining diagram is a graph in which the axes measure game-cents; a "region of possible payoffs" is defined as the points in the first quadrant lying on or below a "compatible demands curve" whose shape depends on three parameters which relate to the diagram's scale or "size," its "bias" toward the horizontal or vertical axis, and its convexity or "curvature" toward or away from the origin.

In general, a subject is instructed to demand an amount of game-money along the horizontal axis and is informed that he has an opponent who demands along the vertical axis; if the two demands intersect within the region of possible payoffs each receives the amount of game-money he demanded, while if they intersect outside this region both receive nothing. In one experiment subjects make on each diagram a single binding demand against an unknown opponent. In another each subject makes a "negotiation" demand which does not count; after being told his opponent's negotiation-stage demand he makes a second demand which is binding. Actually, the "opponent's" demand, like the diagram shapes, is controlled by the experimenter. In the third experiment subjects bargain directly with each other.

To reinforce the profit motive subjects are told they will be paid at the end of the study in direct proportion to their game-cents scores at a previously announced exchange rate. Considerable attention is devoted to other problems concerning control of the experiment environment.

Of especial interest is the use made of the branch of statistics called experiment design. Each of the experiments is set up as a randomized complete-block factorial experiment, with the three diagram parameters and "opponent's" negotiation-stage demand being the factors. This design makes possible the testing of null hypotheses that the "bargaining boldness" of the group or an individual, as measured by suitable transformations of the game-cents demands, is a behavior constant which is unaffected by any of the factors, their interactions, or various components of the factors and interactions. Measures are derived for other strategic aspects of behavior, such as bargaining leverage and degree of bluffing; and similar null hypotheses are tested. The suitability of the analysis-of-variance model is considered, as is the possibility of analyzing "bargaining agreement" with a components-of-variance or mixed model. Finally, it is determined which subjects use the more well-known approaches to non-zero-sum games, such as the von Neumann-Morgenstern, Nash, equalizing, and all-or-none solutions.

Because only a small number of subjects participated, and because several assumptions of the bargaining and analysis-of-variance models fail to be fully satisfied, it is urged that the conclusions be viewed as illustrations of how modern statistical methods can be used in conjunction with laboratory experiments to study economic behavior.

Microfilm $3.75; Xerox $12.05. 289 pages.

EDUCATION, GENERAL

A SURVEY OF SCHOLARSHIP–GUIDANCE PRACTICES IN SELECTED SECONDARY SCHOOLS

(L. C. Card No. Mic 61-1859)

Cynthia Ellen Benzing, Ed.D.
University of Pittsburgh, 1961

The purpose of this study was to determine the scholarship guidance practices that have enabled high school graduates to obtain scholarship aid to assist them in pursuing further study in degree-granting institutions of higher learning. Underlying the study resided the basic assumption that it is in the interests of society and the individual that talent be developed as fully as possible regardless of the individual's economic resources.

The data for the study were collected from two groups of people who were concerned with scholarship guidance, namely, 245 students who received scholarships for study in degree-granting colleges and universities in 1958 or 1959, and 20 school counselors who were concerned with scholarship counseling. The list of scholarship winners was selected by means of a random sample from lists of such winners furnished by high school principals in Delaware, Maryland, New Jersey, and Pennsylvania. A questionnaire was devised and submitted to a pilot group of 20 scholarship winners. Then they were interviewed. From this procedure the questionnaire was refined and mailed to 500 students, of whom 245 replied. The data from the questionnaires contributed a major portion of the findings. Responses from the inquiry to the counselors were also illuminating.

It was found that information about scholarships was mainly received by these scholarship winners during their junior and senior years in high school. It was mainly in these years also that personal encouragement to compete for and qualify for scholarships came from counselors, teachers, parents, and others. Students testified that such encouragement was of prime importance in stirring them to seek scholarship aid.

Since rank in high school class was stated by these students as a most important factor in their scholarship winning, and since that ranking depends upon the record made by the pupil in all the years of high school, a clear recommendation growing out of this study is that those pupils who have the potential for achieving an excellent scholarship record should be identified as early as the eighth grade and given scholarship guidance at that time. Since these students also testified to the importance of the factor of financial need in determining their awards, the eighth-grade identification should also take this into account. While colleges provided more of the scholarships won by these students than any other source, the range of sources, the variation in size of awards, and the variation in qualifications for them, were such as to recommend that scholarship guidance should be highly individual. That is, the counselor is challenged to know scholarships, to know students, and to do a refined job of matching the two.

Microfilm $2.75; Xerox $8.60. 187 pages.

AN INVESTIGATION OF THE EXPRESSED GOALS OF CERTAIN HOME ECONOMICS EDUCATORS AND THEIR STUDENTS WITH IMPLICATIONS FOR HOME ECONOMICS EDUCATION

(L. C. Card No. Mic 61-1006)

Florence June Clarke, Ed.D.
Cornell University, 1960

This study was directed toward investigating the expressed goals of certain home economics educators and their students with the hope that the results might lead to a better understanding of the goals which these persons held to be significant for their profession. The following hypotheses were tested:

It is possible to identify and investigate the stated goals of certain teacher educators and senior students in colleges of home economics in the United States today.

The stated goals of home economics students in their senior year of college are related to those of their teachers.

Statements of goals of teacher educators and college students have implications for the pre-service and in-service training of home economics teachers.

The beliefs of teacher educators concerning home economics education consciously and unconsciously become part of the underlying philosophy of their students.

The investigator used as bases for the inquiry previous research in the study of values conducted by Woodruff, Cutler and Di Vesta. Following the method described by Woodruff for constructing a values test a questionnaire booklet was developed entitled "Which Choices Would You Make?" In this test booklet each respondent was asked to rank twice a series of eight goals for home economics. The first ranking was considered a verbalized one and the second ranking was considered a functional one resulting from the use of the paired comparison or forced choice technique. Usable responses to the mailed questionnaire were received from 778 persons in thirty-six states: ninety-one home economics teacher educators and 687 senior students who were prospective home economics teachers. These persons were associated with thirty-five land grant institutions in the United States and four additional colleges in Florida, Mississippi, Texas and Virginia.

Data received from the teacher educators and senior students were statistically treated in three ways for the groups and subgroups within the population sample.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

Spearman rank order correlation scores were computed between the verbal and paired comparison ranking of the eight goals, profiles of ranks of the goals were determined from the paired comparison rankings and the coefficient of concordance was found for groups and subgroups.

The results of the study indicated that the four hypotheses could be accepted in part, if not in their entirety. Hypotheses two and three were accepted in their entirety and hypotheses one and four were accepted in part. The author identified and investigated the stated goals of the respondents insofar as the design of the study and the clarity of the questionnaire permitted. With reference to hypothesis four, the answers given in the questionnaires did not indicate as to whether the students were conscious of the goals which were held by their teachers. There were strong indications, proved by significant statistical results, that the stated goals of home economics students in their senior year of college are related to those of their teachers. The results also indicated strongly that the stated goals of teacher educators concerning home economics seem, perhaps unconsciously, to become a part of the underlying goals of their students.

Significant implications from this study for home economics education are that:

Home economics teacher educators have responsibilities for helping undergraduates to form a sound philosophy of education as a basis for teaching.

Home economics teacher educators may need to realize some of the differences between their ranking of goals for home economics and the ranking of goals for home economics by their students.

Microfilm $3.10; Xerox $10.80. 238 pages.

A COMPARATIVE STUDY OF THE INTEREST PATTERNS OF STUDENTS ENROLLED IN SELECTED CURRICULA AT PRAIRIE VIEW AGRICULTURAL AND MECHANICAL COLLEGE, TEXAS, 1956-1958.

(L. C. Card No. Mic 61-1753)

Norman Jack Johnson, Ed.D.
University of Michigan, 1961

The purpose of this study was to investigate the relationships of the interests of Negro students enrolled in various curricula at Prairie View Agricultural and Mechanical College during the academic years, 1956-1957 and 1957-1958.

Indications of interests from these students were obtained from the Mitchell-Roeber Check List which contained the following major areas of interest: (1) School subjects, (2) Sports and games, (3) Cultural and Scientific Activities and hobbies, (4) Social activities and services, and (5) Part-time jobs.

Fifteen curriculum areas in which the students were enrolled were included in the study.

The population investigated consisted of 3,133 students (1,513 men and 1,620 women).

Three general procedures were followed in organizing and analyzing the data used in the study:

The data obtained on the population from the Mitchell-Roeber Interest Checklist were classified according to curriculum area enrollment of each student and by sex of each student. The classified totals were converted to percentages for comparison with each item on the Interest Checklist.

The t-Test of percentage difference was applied to the relationships between the following six arbitrarily selected curriculum areas (Biology, Business Administration, Elementary Education, Industrial Education, Music, and Physical Education) and each of the thirteen interest items, to obtain a sample of the significance of the positive or negative relationship obtained.

The third general procedure was designed to discover how closely the men and women students agreed in their selection of interest items. For this purpose the formula of Expected Value was employed.

An analysis and summary of the data revealed important differences existing between the interests of men and women students.

For example, women tended to show greater interest than men in such areas as language arts, aesthetic, secretarial, and home-making school subjects while men indicated more interests than women in school subjects such as advanced mathematics, physical sciences, and the mechanical arts and crafts. Other interest differences by sex were found in the areas of sports and games, cultural and scientific activities and hobbies, social activities and services, and part-time jobs.

Observable important similarities of interests and interest patterns among the various curriculum groups were also found as a result of the study.

For example, students in the Elementary Education Curriculum Group were 85% in agreement on the interest items under school subjects and continued this high pattern of agreement for the items in the remaining four interest categories. In a like manner other similarities existed in varying degrees for the remaining curriculum groups.

Finally, observable important differences in interest patterns were found for each curriculum group. For example, when each curriculum group was compared, according to sex, with other curriculum groups, interest patterns were noted to exist which were unique to that group. Choices for interest items, such as those in the category of school subjects, were closely related to the curriculum in which the students were enrolled.

Based on these findings, the conclusion was reached supporting the major hypothesis that: An important relationship exists between certain student interests and certain curriculum areas.

Further research is recommended in this area.

Microfilm $5.00; Xerox $17.80. 392 pages.

THE DEVELOPMENT OF AN INSTRUMENT TO DETERMINE VALUE PATTERNS OF HOMEMAKING TEACHERS

(L. C. Card No. Mic 61-1007)

Barbara Louise Osborn, Ph.D.
Cornell University, 1960

The purposes of this study were to:

1) construct an instrument which will determine the value patterns of high school homemaking teachers and of prospective teachers;
2) determine the qualities of the instrument as a research tool; and
3) evaluate the instrument in terms of its ability to measure value patterns and to reveal variations in value patterns.

The research is one of a series of studies concerning teacher effectiveness in progress in the Department of Home Economics Education, New York State College of Home Economics at Cornell University.

The study is based on the possibility of a relationship between value patterns and effective teaching. Since a survey of available values tests disclosed none appropriate for studying values of homemaking teachers, the writer constructed a test for this purpose. The procedure followed in developing a values test included:

1) statement of basic assumptions;
2) statement of purpose of test;
3) selection and definition of values; and
4) determination of form of test including behavioral situations, facilities for recording responses, scoring methods, and technique for interpretation.

Values are defined, for purposes of this study, as orientations or guides which are so important to a person that they affect the way he defines a situation and, therefore, the way he reacts to that situation. A value pattern is the relationship among values being considered. Nine values were selected for use in the study:

1) people-oriented values which represent behavior directed toward others
   - A. importance of people
   - B. work with people
   - C. helpful to others
2) Self-oriented values which represent behavior intended to benefit the person himself
   - D. achievement
   - E. independence
   - F. creativity
3) "Other"-oriented values which represent behavior directed toward material rewards and standards set by some group outside the person but to which he might belong
   - G. security
   - H. prestige
   - I. conformity

Several methods of testing were explored to the extent of developing preliminary tests. The instrument on which the study is based employed an adaptation of the paired-comparison method and met the criteria used by the author to evaluate published values tests:

1) Values were defined in terms of human behavior.
2) Values were universal and recognized as being related to teacher behavior.
3) Situations were related to classroom and personal decisions.
4) Results could be interpreted in terms of understanding value patterns.
5) Scoring resulted in a value pattern based on relationship of values as revealed by ranking.

Two drafts of the instrument were pretested, the "original" form with 19 subjects and the "revised" form with seven subjects. The "final" form was administered to 200 homemaking teachers, 94 student teachers, and 37 business home economists.

The analysis of the test provided information concerning the qualities of the instrument as a research tool, its ability to determine value patterns, and its ability to reveal variations in value patterns. The analyses were nonparametric due to the nature of the data. Rank correlation coefficients were computed using Spearman's formula for two measures of reliability (test-retest correlation coefficients yielding reliability over time and rank correlation coefficients between part one and part two measuring internal consistency). Two measures of validity were used (an empirical test employing Kendall's coefficient of concordance and rank correlations to measure agreement between pupil and teacher responses, and content validity based on percentage of agreement on identification of values by the writer and teachers). Kendall's coefficient of concordance was used to measure amount of agreement within groups. Variations were determined by analysis of range of ranks, ties in rankings, groupings of values, and agreement within subgroups of the teacher sample.

Evidence presented from the analysis of the administration of the three forms of the values test leads to several conclusions related to the stated purposes of the study.

1) The values test as constructed and revised will determine value patterns of homemaking teachers and of prospective teachers.
2) The values test is highly reliable over time as determined by test-retest reliability.
3) The values test reveals two value patterns as determined by a measure of internal consistency with part one indicating preferences related to teaching and part two indicating personal preferences.
4) An empirical test of validity employing the use of pupil responses to validate teacher responses was sufficiently positive to provide a small measure of support to the validity of the test.
5) The test exhibits content validity through the agreement on identification of values by the writer and the validity sample of homemaking teachers.
6) Value patterns can be identified and there is a tendency for respondents within sample groups to agree on value patterns.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

7) Variations are present for individuals within sample groups.

8) Responses from student teachers and business home economists did not differ from responses from teachers.

Microfilm $2.95; Xerox $10.15. 225 pages.

A SITUATIONAL ANALYSIS OF PUBLIC SCHOOL ENROLLMENT IN THE PHILIPPINES

(L. C. Card No. Mic 60-6927)

Quirico Segundo Samonte, Jr., Ph.D.
University of Michigan, 1960

Proceeding from the assumption that a school system is a part of and is conditioned by the character of the society in which it is situated, this study examines how a number of selected situational factors are associated with size of public school enrollment in the Philippines as of 1939. These situational factors include (1) land tenure, (2) age composition, (3) population pressure, (4) level of living, (5) relative frequency of Protestants, and (6) relative frequency of non-Christians.

The forty-nine provinces are used as units of analysis, and the data are drawn largely from (1) the Philippine Census of 1939, and (2) the Forty-First Annual Report of the Director of Education for the period covering July 1, 1939, to June 30, 1940.

Based on correlation coefficients obtained in the analysis, enrollment in the public elementary schools is found to be positively associated with (1) the percentage ratio of ownership to tenancy by area of farms (.332), (2) the ratio of the "economically active" (20-64 years of age) to other age groups (.014), (3) level of living (.338), and (4) the relative frequency of Protestants (.167). On the same school level, enrollment is negatively associated with (1) population pressure (-.131), and (2) the relative frequency of non-Christians (-.566).

By comparison, enrollment in the public high schools is found to be positively associated with (1) the percentage ratio of ownership to tenancy by area of farms (.425), (2) the ratio of the "economically active" (20-64 years of age) to other age groups (.264), (3) level of living (.245), and (4) the relative frequency of Protestants (.245). On the same school level, enrollment is negatively associated with (1) population pressure (-.119), and (2) the relative frequency of non-Christians (-.276).

In addition to comparing the influence of these situational factors on enrollment by school level, further refinement in the analysis is obtained by the use of partial correlations to "parcel out" the association of a number of selected control variables. These control variables include (1) the gross peso value of annual agricultural production per capita, (2) enrollment in the private schools, (3) availability of public schools, and (4) the accessibility of public schools.

The study concludes with (a) a summary of the findings, (b) an analysis of their implications for the contemporary Philippine setting, and (c) a list of research categories suggested for further study in comparative education.

Microfilm $2.75; Xerox $6.60. 139 pages.

AN ANALYSIS OF THE RESOURCE-USE EDUCATION PROGRAM OF NORTH CAROLINA COLLEGE AT DURHAM

(L. C. Card No. Mic 61-1793)

Theodore Roosevelt Speigner, Ph.D.
University of Michigan, 1961

Resource-Use Education is designed to increase the effectiveness of the educational program in dealing with problems and total development of the pupils, the school, and the community. Until a strong desire for Resource-Use Education exists in the minds of men, Resource-Use Education goals cannot be achieved. There must be an awareness on the part of the public as to the urgent need for Resource-Use Education practices in all phases of resources utilization.

It is the purpose of this study a) to analyze the history of the Resource-Use Education Program of North Carolina College at Durham, b) to describe and analyze the purpose, objectives, and organization of the Workshop in Resource-Use Education and the Resource-Use Education Conferences, c) to make a comparative analysis of certain selected teaching practices of a random sample of thirty teachers who attended the Workshop in Resource-Use Education at North Carolina College at Durham with the teaching practices of a similar number of teachers who had had no training in Resource-Use Education, and d) to make an analysis of current teaching practices of teachers in the Experimental Group with their teaching practices before and after their workshop experience.

In Part I of the study is a general descriptive analysis of the history, purpose, organization and administration of the Resource-Use Education Program of North Carolina College at Durham. The extent to which public school teachers and participating schools have utilized the resources and services of the College is included. The historical overview of Resource-Use Education in the South, in North Carolina, and at North Carolina College at Durham is examined.

Part II is a descriptive analysis of the Workshop in Resource-Use Education and the Resource-Use Education Conferences sponsored by North Carolina College at Durham. It deals with an analysis of the purpose, organization, program-content, and procedures of the Workshop in Resource-Use Education and the Resource-Use Education Conferences which teachers are exposed who participate in the College's Resource-Use Education Programs.

Part III is an analysis of certain selected teaching practices of a random sample of thirty teachers in the public schools of North Carolina who attended North Carolina College at Durham's Workshop in Resource-Use Education with a similar number of teachers working under similar situations who had had no training in Resource-Use Education. Part III also compares the teaching practices of teachers in the Experimental Group with their own teaching practices before and after the workshop experience.

Although a number of general conclusions are drawn from the study, six significant findings seem most important.

1. That teachers who attended the Workshop in Resource-Use Education at North Carolina College at Durham utilized natural and community resources more effectively in their subject matter areas than those who had no training in Resource-Use Education.

2. The largest percentage of teachers in the Experimental Group used natural resources projects, understandings, units, and activities while human resources and simpler activities were employed by teachers in the Control Group.

3. High school teachers in both the Control and Experimental Groups used a slightly smaller number of outdoor education techniques than did the elementary groups.

4. Both the Rural and Urban Experimental Groups exceeded the Rural and Urban Control Groups in the percentage of teachers using audio-visual activities.

5. Consistently, the Experimental Group in all areas investigated in this study exceeded the Control Group in utilizing Resource-Use Education understandings, techniques, projects, practices, units and activities.

6. The over-all results of the study would seem to indicate that teachers in the public schools of North Carolina who attended the Workshop were more creative in integrating and correlating the natural, social, and human resources into the subject-matter areas in both the elementary and high school curriculums.

Microfilm $4.25 Xerox $14.85. 329 pages.

THE JACKSON STATE COLLEGE GRADUATE IN AMERICAN SOCIETY: A FOLLOW-UP STUDY OF 306 GRADUATES, 1944-1953.

(L. C. Card No. Mic 61-1111)

Cleopatra Davenport Thompson, Ed.D.
Cornell University, 1960

THE PROBLEM

It was the purpose of this study to obtain information concerning:

(1) the occupational opportunities and economic status of the Jackson State College graduates, Jackson, Mississippi,

(2) the nature and extent of their professional and personal growth,

(3) the nature and extent of their participation in community and leisure time activities,

(4) the respondents' appraisals of their college education, and

(5) the implications of the findings for the teacher education program at Jackson State College, Jackson, Mississippi.

PROCEDURES

In carrying this problem through to completion, literature related to the inquiry was reviewed. As background materials, public education in Mississippi, 1940-1959, and Jackson State College records, 1877-1959, were studied. Questionnaire data were obtained with an instrument amended in the light of experiences gained in a preliminary pre-test. Three hundred six of the 518 graduates whose addresses were known responded to the inquiry.

These data were coded and key punched on International Business Machine cards; then, counts from the sorting operations were recorded on forms that were used for table constructions.

SUMMARY OF MAJOR FINDINGS

Ninety-nine of the 306 respondents were men and 207 were women. Significant gains as compared with first jobs and beginning salaries were characteristic of the occupational and economic status of the alumni. As of 1958, the median salary for men employed in Mississippi was $3,479.50 and $3,059.50 for women; for men employed outside of the state, $5,599.50 and for women $4,709.50. Alumni who had migrated to other states were generally making better salaries than those who remained in Mississippi. It appears that a majority of the Jackson State College graduates find satisfaction in educational occupations and they stay in this field. This suggests that the school's emphasis on teacher education is a proper one and should be continued.

Opportunities to pursue professional and graduate training were unusually limited. In spite of this, 75 per cent of the alumni had completed further study beyond the undergraduate degree, with 7 persons having earned another bachelor's degree, 48 the master's degree, 23 additional training beyond the master's degree, and 3 the doctoral degree.

More than half of the graduates appear to be limited in economic, social, and cultural outlets. The respondents followed the national trends in mobility, reading habits, and in participating in civic affairs, such as voting and political meetings; however, fewer of the Jackson State College graduates participated in the latter activities. More of the alumni in this study were active in religious, welfare organizations, and professional affairs than was true for other groups studied.

Alumni were quite well agreed in finding the emphasis on courses in Rural Living (practical courses) too great and not useful. They were also in agreement in wanting to see the academic program strengthened.

In general, the graduates felt that the college had made distinct contributions to their adult lives, especially in the areas of intellectual development, preparation for a vocation, and in developing a philosophy of life. Emotional stability appeared to have been the area in which college training had been least effective.

RECOMMENDATIONS AND PROBLEMS FOR FURTHER STUDY

1. There should be closer articulation between Jackson State College and high schools of the state.

2. The college should consider offering professional courses in the fifth year.

3. The expansion of the enrollment and program of the college indicate the need for continuous evaluation of curricular offerings.

4. Extended research should be considered for identifying, recruiting, and providing for the education of more talented Negro youth.

5. Data presented in this study make it clear that Jackson State College should have increased financial support from the state.

Microfilm $2.75; Xerox $8.60. 189 pages.

A STUDY TO DETERMINE THE VALIDITY OF PART VI, SECRETARIAL PROCEDURES, OF THE CERTIFIED PROFESSIONAL SECRETARIES EXAMINATION.

(L. C. Card No. Mic 61-1819)

Margaret Duncan Zaugg, Ph.D.
University of Michigan, 1961

The purpose of this study is to test the validity of Part VI, Secretarial Procedures, of the Certified Professional Secretaries Examination. This entails the determination of: How scores received by examinees on the test correlate with ratings which the employers have made of the on-the-job performance of the duties covered by the items in the test. This is based on the predication that a passing score on this section of the test should signify to an employer that the performance of an examinee who earns such a score will be superior to that of an examinee who received a failing score.

In the preliminary part of the study, discussed in Chapter II, a Secretarial Procedures Scale for rating on-the-job performance of the duties included in the test was constructed. It was tested on a group of 47 Toledo, Ohio, secretaries. The instrument used as a criterion was the Industrial Psychology, Incorporated's Clerical Performance Rating Form. The secretaries selected for the study each worked for two employers who rated her performance on both instruments. A Pearson product-moment correlation between the scores on the two instruments gave a coefficient of .84 $\pm$.06. This indicated that the Procedures Scale was a satisfactory instrument to use for the final part of the study. Chapters III and IV present the final part of the study in which the Procedures Scale was used to obtain employer ratings of the on-the-job performance of a sampling of 184 examinees who took Section VI of the test in 1959. The sampling included examinees who were repeating the test as well as ones who were taking it for the first time. The ratings of these examinees were correlated with the test scores they received, and the result was a Pearson product-moment coefficient of .15 $\pm$.07. This indicated a negligible relationship. Other factors were considered, and correlations between these and test scores gave eta coefficients as follows: Education, .15 $\pm$.17; Years of experience as secretaries, .09 $\pm$.07; Age, .21 $\pm$.06. Comments received from some of the raters indicated that subjective factors influenced their ratings.

The conclusions which can be drawn from the study are: 1) A passing score on the test does not indicate any better on-the-job performance than a failing score; therefore, on the basis of this predication, the section of the test under study would not be considered valid; 2) The nature of secretarial work is such that subjective factors must be considered if any true evaluation is to be made of a secretary's performance of her duties; and 3) Neither the amount of an examinee's education, nor her years of experience as a secretary, nor her age is a significant indicator of her probable success on Section VI of the test.

Microfilm $2.75; Xerox $7.00. 147 pages.

EDUCATION, ADMINISTRATION

AN ANTHROPOLOGICAL APPROACH TO ADMINISTRATIVE CHANGE: THE INTRODUCTION OF A GUIDANCE PROGRAM IN A HIGH SCHOOL.

(L. C. Card No. Mic 60-5080)

Mark S. Atwood, Ph.D.
Columbia University, 1960

This is a second listing. For abstract please see page 3586. Microfilm $4.95; Xerox $17.55. 387 pages.

A STUDY OF CONSTRUCTION AND MAINTENANCE COSTS IN RELATIONSHIP TO TRUE ECONOMY OF SCHOOL OPERATION

(L. C. Card No. Mic 61-1276)

Thomas A. Backus, Ed.D.
The Florida State University, 1961

This study was directed toward determining the most economical floor, roof, wall, and window materials and types of construction for school purposes. For each item studied, the average maintenance cost adjusted to the January 1959 level was added to the January 1959 construction cost and its total compared with other totals to determine which was the more economical. The construction costs used were the January 1959 Dade County costs of construction and were about average for the State of Florida. Maintenance costs were obtained by studying the maintenance expenditures in Hillsborough and Pinellas Counties. The amount expended on each item was divided by its square-foot-years-of-experience (area times years studied) to obtain an average maintenance cost per square foot per year. This rate was multiplied by one hundred to give a rate per square. The construction and maintenance costs were combined to determine comparative total costs at any time to the end of fifty years.

According to the tables and graphs of these comparative costs, concrete floors are the most economical after a fifty-year span. Unfortunately they are unacceptable for classroom purposes. A grade "C" asphalt tile on a concrete slab poured on the ground with low preventive maintenance, is probably the most economical of the resilient type floors, although not completely acceptable because of its dark color. Wood floors, properly installed and properly maintained, are probably the most economical when everything is considered. Asphalt tile is the most economical cover for the concrete slab in the classroom, but vinyl or grease-proof tile is more economical in the areas where floors are heated or where there is danger of chemical damage.

The galvanized roof is the most economical over a long period of time but its insulating quality and aesthetic appeal are poor. Asphalt shingles provide a choice of color and better insulating quality and cost only slightly more. Pitch and gravel roofs are the most economical for flat decks but are more expensive than galvanized or asphalt shingle roofs. Spanish tile and asbestos shingles, while more expensive, are frequently used for aesthetic reasons.

Concrete block walls are the most economical over a span of time, due largely to cheaper construction costs. Stucco gives a better appearance and is more economical to maintain, but its higher construction cost more than balances its maintenance savings. Of the walls studied, brick is the most economical to maintain; but its high construction cost cannot be made up by the savings in maintenance in any reasonable length of time. Brick is sometimes used for aesthetic reasons in spite of the high cost. The high maintenance cost of wood buildings eliminates them from consideration except for temporary and portable buildings in Florida.

Steel windows are the most economical of those studied, although in some areas aluminum ones are cheaper to install. Since all windows are so very expensive both to install and to maintain, it seems that completely eliminating or greatly restricting their area in classrooms is one way to true economy.

Microfilm $2.75; Xerox $7.20. 155 pages.

AIMS AND OBJECTIVES OF ELEMENTARY SUMMER SCHOOLS IN THE UNITED STATES

(L. C. Card No. Mic 61-1694)

Rexford Wells Bolling, Ed.D.
University of Southern California, 1961

Chairman: Professor Stoops

The purpose of this study was to furnish a description and listing, in order of relative importance, of the aims and objectives of elementary summer schools for school districts which wished to make use of existing research in order to set up their own summer school programs. Another purpose was the presentation of a detailed outline of contemporary objectives of elementary summer schools throughout the United States, so that a school's administration might pick and choose among those listed as current objectives.

Findings. (1) Four of nine categories of summer school objectives are considered important by at least half of the respondent administrators: (a) study skills objectives, (b) recreational and therapeutic objectives, (c) remedial objectives, and (d) gifted child objectives. (2) Four of the nine areas of summer school objectives are rejected at all district levels: (a) service objectives, (b) enrichment objectives, (c) human relations objectives, and (d) civic responsibility objectives. (3) Remedial reading was the single most popular objective of elementary summer schools. (4) For intermediate and upper grades, remediation objectives were usually concerned with the three R's. (5) Remediation of school subjects was considered less important at the primary level than at the upper two levels. (6) Interest in gifted child objectives was restricted largely to Class IV cities at the upper two grade divisions. (7) Curricular enrichment was popular with the largest districts at the upper two grade divisions. (8) Interest in science and mathematics objectives was shown primarily by the largest and the smallest districts. (9) Recreational and therapeutic objectives were approved by the smallest cities. (10) Most popular enrichment objectives pertained to work with gifted children, science, mathematics, and the three R's, especially at the upper elementary level. (11) The fostering of curriculum objectives as a primary purpose of summer school programs was rejected by all districts at all levels. (12) Each city-size category exhibited certain choices which were unique to that category. Class IV cities exhibited interest in the quasi-legal aspects of attending summer schools, Class III cities stressed social aspects, Class II cities were mainly concerned with curriculum, and Class I cities showed a willingness to assume responsibilities of the home as well as those of school.

Conclusions. (1) In general, administrators in charge of elementary summer school programs tend to rely upon a curriculum that stresses the academic core of education and the remediation of that core. (2) A multiplicity of summer school offerings is more common in small districts than in large districts. (3) Certain types of summer school offerings are characteristic of certain sizes of districts. (4) Contrary to expectation, little interest is exhibited in special educational opportunities for the gifted. (5) Intermediate and upper grades tend to stress the areas of science, mathematics, and study skills as summer school objectives.

Recommendations. (1) School districts will do well to settle on one person or a small group of professional persons to assume the primary responsibility for the development of summer school programs at the elementary level. (2) It should be recognized that aims and objectives are flexible, at least in their more specific terms; that they are established for the purpose of meeting the needs of education. (3) Therefore, it should be a function of the person or persons responsible for developing aims to develop a list of needs of the district first. (4) The necessity for accentuating the academic core of education during the summer is well supported by the opinions of the respondents. (5) Districts, however, should seize upon the opportunity to use the summer school period as an experimental time to supplement academic work and remedial experiences. (6) School districts should avoid accepting duties which are more rightly assumed by the home.

Microfilm $3.40; Xerox $11.95. 261 pages.

A STUDY OF ACADEMIC PROBATION AND SUSPENSION POLICIES AND PRACTICES AND THE OUTCOMES OF THESE POLICIES AND PRACTICES IN REPRESENTATIVE PUBLIC JUNIOR COLLEGES

(L. C. Card No. Mic 61-1281)

Thomas C. Dula, Ed.D.
The Florida State University, 1961

The purpose of the study was first to assess probation and suspension policies and practices in junior colleges of the United States, and second to discover whether differences in educational outcomes result from the application of varying policies and practices.

Answers were sought to the following questions: (1) What are the policies and practices found in selected

public junior colleges? (2) How long do students continue after having been put on probation? (3) What proportion of students return to school following a period of suspension? (4) How many students continue on to graduation after having been subject to academic regulations? (5) Does a student's age or sex have a bearing on how well he responds to certain regulations?

Procedures

The study was executed in two phases. The first was a survey of probation and suspension policies and practices. The second was an assessment of the records of students who had been subjected to varying academic regulations.

The investigation was limited to regionally accredited, publicly supported, and locally controlled junior colleges. One hundred forty-nine institutions met these criteria.

Based on the degree of restrictiveness of suspension and probation policies and practices, institutions were categorized as being highly restrictive, moderately restrictive, and liberal. Twenty-seven institutions provided information on the academic progress and success of students who had experienced scholastic difficulty and had been subjected to academic regulations.

Findings and Conclusions

1. Policies and practices of academic probation and suspension range from conditions of considerable restrictiveness to conditions which are so permissive that they are practically non-existent. Using the criteria employed, the institutions were distributed as follows: highly restrictive – 35, moderately restrictive – 51, and liberal – 63.

2. The relative degree of restrictiveness of academic probation and suspension policies and practices has little to do with survival.

3. There is a tendency to place more stringent requirements on students in academic difficulty than on those who are not.

4. As a group, men students seemed more susceptible to academic difficulty than women students.

5. Students above the age of 21 were not influenced by policies and practices of academic probation and suspension in as great a proportion to their number as were those in the 17 through 21 age group.

6. Relatively few of these students were subject to suspension regulations. This seems to be true because such a small proportion of those who were placed on probation continued to the point of suspension. The following findings indicate that placing a student on probation constitutes a "freeze out" process.

   a. The very act of placing a student on probation was, in itself, tantamount to dismissal for over one-third of such students.

   b. As a group, students who had experienced probation at some time during their junior college attendance earned less than a normal year's credit.

   c. In general, students who were subject to probation regulations at some time during their college attendance did not continue more than one semester after having been placed on probation.

7. Fewer than 10 per cent of public junior college students placed on probation graduated within a four year period.

8. Due to the low survival rate, and the small number of semester hours earned by students subject to academic regulations, this study provides little evidence that policies and practices of academic probation and suspension cause students in academic difficulty to do better work.

Microfilm $2.75; Xerox $4.40. 85 pages.

ATTITUDES OF A SELECTED GROUP OF ELEMENTARY SCHOOL TEACHERS TOWARD IN-SERVICE EDUCATION

(L. C. Card No. Mic 60-5233)

Carl H. Hempel, Ph.D.
The University of Connecticut, 1960

It was the purpose of this study to gather facts concerning the education and experiential background of a random selection of public elementary school teachers in Connecticut; to get some measure of each teacher's knowledge of agreements among psychologists concerning the learning process; to discover teachers' attitudes toward contemporary programs of in-service training; and to discover relationships between the attitudes of teachers toward in-service training programs and their knowledge of agreements of educational psychologists concerning the learning process.

Information was obtained by sending questionnaires to 1551 teachers in a random selection of elementary schools in Connecticut. Usable returns were received from 1191 elementary teachers.

The mean age of teachers responding was 35.2 years; 20% had no degrees, 62% had bachelor's degrees, and 14% had master's degrees; respondents were distributed almost evenly by grade; mean years of experience was between ten and eleven; 62% were educated at teachers colleges, 24% at liberal arts colleges, and 14% at schools of education at universities.

Respondents reported the following types of in-service training to be valuable: (listed in order of preference)

Graduate study leading to a degree
Workshops under direction of university staff
Individual study not connected with college or university
Extension courses not leading to degrees
Local in-service activities other than workshops
Workshops under local leadership

Only slightly more than half the teachers ever felt need for further in-service education. Teachers felt needs for further education in the following areas:

Methods Courses	34%
Content courses	30%
Related courses,--guidance, law, finance, etc.	17%
Psychology courses	14%
Philosophy courses	5%

On a test designed to measure knowledge of agreements of psychologists concerning the learning process, scores of 1191 respondents ranged from 0 to 47, with a mean of 27. Positive relationship between teachers' scores on the

test and their attitudes toward in-service education was significant at the 1% level of confidence in the following areas:

Graduate study leading to degrees
Extension courses not leading to degrees
In-service education early in the career
In-service education now

However, correlations were low and therefore viewed with caution in asserting that high scores on test of knowledge of learning theory indicated desirable attitudes toward in-service education.

No significant difference was found in relationship between scores on the test and attitudes toward:

Workshops under direction of a university
Professional study not connected with any institution
Workshops under local direction
Local in-service activities other than workshops

Comparison of values assigned by teachers whose scores were 1-$\frac{1}{2}$ Sd. above the mean on the learning test and those whose scores were 1-$\frac{1}{2}$ Sd. below the mean revealed that those who scored high on the test assigned higher value than those who scored low on the test to the following types of in-service education:

Graduate study leading to degrees
Professional study not connected with any institution
Extension courses not leading to degrees
Workshops under local leadership
Local in-service activities other than workshops
In-service education early in the career
In-service education now

Workshops under direction of a university were assigned high value by both high and low scorers on the test.

It was concluded that knowledge of learning theory may be one factor affecting teachers' attitudes toward in-service education and that there was a tendency for those who knew more about learning theory, as measured by the test, to hold more desirable attitudes toward in-service education. Microfilm $2.75; Xerox $6.80. 144 pages.

COMMUNICATION AND DECISION-MAKING IN SCHOOL BOARD-SUPERINTENDENT RELATIONS: A CASE STUDY.

(L. C. Card No. Mic 61-2085)

Louis Edward Holden, Ed.D.
University of Oregon, 1961

Adviser: Keith Goldhammer

The problem with which this study is concerned is the identification of communication channels and the interrelationship existing between the superintendent of schools, members of the board of education, and certain individuals in the community. The focal point of the study is communication in school policy development.

Material gathered through use of both observation and interview is presented in the form of two case studies. In each instance, the research observer spent more than a year in establishing rapport, attending all board meetings, interviewing, and generally developing an understanding of the community and its problems.

The following conclusions from the case analysis were drawn:

1. As information passes through the communication network, it tends to move in irregular patterns through selected channels rather than in a progressive and regular geometric pattern because the individuals through which information flows are highly selective in their reception and transmission of information.
2. Family visitation patterns of decision-makers' families showed little evidence of influencing the formulation of educational policy.
3. Board members tend to be selected and supported by local power cliques.
4. Status as a school board member or as a superintendent of schools does not carry with it the assurance of strong influence in educational affairs.
5. A majority of decision-makers may be advised by only a few influentials who are relatively unknown as active leaders in this capacity.
6. There is evidence indicating that a leadership structure operates within the decision-making team. This "super elite" communicated frequently among themselves between board meetings. In each community this group was composed of the superintendent, the board chairman, and one influential board member.
7. Evidence gathered in this research suggests that the social position of individual board members, together with their geographical location in their communities, are factors which influence their participation and involvement in the communication network. This implies a predictable pattern of communication.
8. Decision-makers are able to identify only a very small percentage of the communication channels utilized by other decision-makers in the formulation of educational policy.
9. Great variation was observed between individual members of the decision-making team in their demonstrated ability to perceive the communication network.
10. The perception with which an individual views one area of the communication network may vary greatly in degree of accuracy with the perception with which the same individual views other areas of the communication network.
11. Evidence suggests that decision-makers who are actively involved in communication between board meetings have a more accurate perspective of the communication network than that held by decision-makers who are less actively engaged in communication.
12. Evidence suggests that decision-makers who are judged to be most influential in school affairs

also have the most accurate perception of the communication network.

Microfilm $2.75; Xerox $7.00. 150 pages.

EDUCATIONAL PLANNING PROCEDURES FOR SCHOOL BUILDING CONSTRUCTION

(L. C. Card No. Mic 61-1697)

Robert Edward Hummel, Ed.D.
University of Southern California, 1961

Chairman: Professor LaFranchi

The purpose of this study was to discover and evaluate procedures being used in developing the educational planning of new school buildings in California. Specifically, the study sought (1) to evaluate suggestions offered in the literature concerning proper methods for developing educational planning of new school buildings, (2) to discover planning methods used in selected California school districts, (3) to ascertain how teachers, principals, classified personnel, architects, the superintendent's staff, the board of education, lay public, public officials, and others were used in planning, (4) to examine suggestions of California school superintendents for improved planning, (5) to analyze suggestions for improved planning methods offered by California architects specializing in school construction, and (6) to recommend how school districts can improve the educational planning of new school buildings.

The data were collected by means of questionnaire returns from selected California school districts ranging from 5,000 to 40,000 in average daily attendance and from selected practicing California school architects. Personal interviews were utilized in an intensive study of good educational planning procedures in selected school districts.

Findings. (1) Written educational specifications had been prepared by 59 per cent of all districts surveyed. (2) Participants in educational planning were, in rank order of frequency of use, architects, principals, coordinators and directors of curriculum, supervisors, teachers, classified personnel (custodians, cooks, maintenance men and transportation workers), members of governing boards, the Bureau of School Planning, the lay public, and county schools personnel. (3) The evaluation of recently completed buildings was used for improved planning by 87 per cent of the districts. (4) Planning directors favored the use of master teachers of long experience, department heads and nonteaching personnel, for assistance in educational planning. (5) Lack of time was the problem most frequently encountered in educational planning. (6) The primary contribution of the administrative staff was leadership; without it planning failed. (7) Architects estimated one fifth of the total school building planning time should be devoted to educational planning. (8) Only two thirds of the architects surveyed had received written educational specifications. (9) Architectects were concerned about the reluctance of school districts to study long-range objectives because of immediate pressures for space. (10) All architects believed the preliminary building plans and specifications should be reviewed by the superintendent.

Conclusions. (1) Written educational specifications, which reflect the best planning contributions of good teachers and others in the district, are the foundation upon which the competent architect bases the school building design. (2) School administrators tend to underestimate the time required for developing good educational specifications. (3) There is merit in group planning; however, school administrators have experienced difficulty in organizing groups for efficient planning action. (4) If personnel are unwilling to devote the requisite amount of time and effort to educational planning, no amount of cooperative planning can yield satisfactory results. (5) Teachers need assistance in learning how to translate educational objectives and methodology into specifications understandable to the architect. (6) Cooperative educational planning results in better school buildings and has a positive influence on morale.

Recommendations. (1) Boards of education should, as a matter of policy, require that written educational specifications be prepared by the cooperative efforts of the most able employees of the school district under capable educational leadership. (2) Responsibilities of planning directors and committees should be clearly defined in writing by board policy before initiating activity, with the understanding that cooperation does not mean capitulation of the necessary administrative control or authority in planning. (3) Planning participants should be carefully selected from interested district groups by administrators having a first-hand knowledge of the capabilities of the candidates. (4) Participants should be organized only for the duration of the specific project. (5) Lines of communication between groups and planning directors should be short. (6) Architects should be employed who possess the necessary technical competence required to translate good educational specifications into the necessary teaching and learning spaces. (7) Sufficient time should be scheduled to insure satisfactory consideration of all aspects of the planning problem.

Microfilm $5.80; Xerox $20.75. 456 pages.

SOME BASES FOR COORDINATION OF COOPERATIVE EXTENSION PROGRAMS WITH RESEARCH AND RESIDENT INSTRUCTION IN SELECTED LAND-GRANT INSTITUTIONS

(L. C. Card No. Mic 61-1533)

George Hyatt, Jr., Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Robert C. Clark

This study was designed to identify and examine some bases for coordination of Cooperative Extension programs with research and resident teaching in four selected land-grant institutions. The specific objectives were to: (1) analyze the historical setting of coordination between extension, resident teaching and research staffs of the four institutions; (2) analyze the nature and degree of differences and why they exist in coordination, particularly in relation to extension program planning, execution and

evaluation in the four states; and (3) identify patterns of organization and kinds of administrative policy that make for optimum coordination between the three functions.

Each of the four selected land-grant institutions represented a different type of organization for extension specialists. These varied from the type of organization in which specialists were nearly completely aligned with subject-matter departments to those completely aligned with extension administration. All department chairmen, research-teaching personnel and extension specialists within the departments of agronomy, agricultural economics and animal husbandry were interviewed and participated in providing data through a pretested questionnaire. Individual interviews were conducted, using open-ended questions, with the Dean of the College of Agriculture and the Directors of Resident-Teaching, Research and Extension. The total sample included two hundred and forty-five persons.

Several hypotheses were developed as the theoretical frame of reference for the study. The following conclusions were formulated: (1) There is a relationship between the degree of coordination effected by extension and research-teaching functions within the four selected land-grant institutions and the historical background related to the coordination of teaching, research and public service of the institution. (2) There were distinct differences between the four types of organizations in relation to the sharing of responsibilities for staffing, programming and budgeting with subject-matter department heads and Directors. Coordination among extension, research and teaching staffs increased considerably in those institutions where these responsibilities were jointly shared. (3) Coordination was found to be greater in the states where personnel identified with the research-teaching and extension staffs participated in regularly scheduled and jointly planned departmental meetings and seminars. Likewise, staff members collaborated with one another in the preparation of joint publications. Coordination was found to be poorest in the state where Extension personnel took no part in departmental activities. (4) When the research-teaching and extension staff personnel jointly collaborate in planning research programs and projects, departmental curricula and extension programs, greater coordination is achieved. The joint appointments between extension-research and extension-teaching seem to improve joint collaboration in the planning of research programs and projects. Such joint appointments also facilitate joint planning and evaluation of extension programs. (5) The research-teaching staff personnel within the three selected subject matter departments at each institution desire greater participation than they now realize in planning, executing and evaluating extension programs. The spread between present participation and what is desired is greater in those states where specialists are more closely aligned with extension administration.

Microfilm $2.75; Xerox $7.40. 160 pages.

A STUDY OF WHITE NON-FLORIDA RESIDENT STUDENTS ENROLLED IN SELECTED FLORIDA COLLEGES AND UNIVERSITIES FOR THE FIRST TIME IN THE FALL, 1958.

(L. C. Card No. Mic 61-1288)

John U. G. Kiefer, Ed.D.
The Florida State University, 1961

The purpose of this study was to provide answers to questions, and to reveal new information about the white students immigrating to the Florida colleges and universities in the fall of 1958.

More specifically information was sought regarding the following questions: (1) Why did these thousands of students migrate to the Florida institutions? (2) Is Florida giving service to thousands of students who will return to their home state, or can one expect some of these students to remain and become Florida residents? (3) What fields of study did these students select? (4) Will they advise others from their home states to attend the Florida institutions? (5) What type occupation do these students eventually hope to enter? (6) What aspect of the Florida college which they are attending has impressed them most favorably? (7) What aspect of the Florida college which they are attending has impressed them least favorably? (8) What is the major source of income for these immigrant students? (9) What relationships exist between the scholastic ability of the undergraduate immigrant sample and the fields of study selected, future residence plans and reasons for immigrating?

Data were gathered by questionnaire technique in such a way as to yield representative answers to questions concerning white non-Florida resident students who migrated to the selected colleges and universities for the first time in the fall of 1958.

The study revealed these findings and conclusions:

1. Courses and programs available at the college was the most influential immigration factor as reported by the men and women immigrant sample group.

2. A relatively small percentage of the immigrant students plan to remain in Florida to live. The men and women proportionately are equal in their decision to remain in Florida. These men and women constitute only one in ten of their respective populations.

3. The immigrant sample selected business administration and teaching most frequently as their fields of study.

4. The immigrant sample reported that they will advise other students from their home states to attend the institutions they are attending.

5. A majority of the immigrant students reported that they planned to enter an occupation that would place them in the professional and technical category.

6. The one most favorable aspect of the immigrant students' institutions was the quality of instruction. This aspect ranked first in all four types of institutions attended by the sample students.

7. An increase in the dependence on family support as the major source of income is associated with students in the private degree-granting institutions when compared to students enrolled in the other three types of institutions. Assistantship or fellowship ranks relatively high as a

major source of income by students in the state university system.

8. Approximately one in four of the undergraduate transfer students in the lowest ability group plan to remain in Florida. Only one in ten of the undergraduate transfer students in the highest ability group report they plan to remain in Florida.

Microfilm $2.75; Xerox $6.80. 141 pages.

RESEARCH AND ITS SPONSORSHIP IN UNDERGRADUATE COLLEGE PHYSICS DEPARTMENTS

(L. C. Card No. Mic 61-1757)

Walter Hillis Kruschwitz, Ph.D.
University of Michigan, 1961

The purpose of this study is to ascertain the prevalence and some of the effects of research in physics departments of colleges that offer an undergraduate major in physics but no courses for graduate credit in this area and to determine the place of sponsorship of the research by agencies outside the school. The importance of the study relates to the increasing number of colleges participating in research activities in physics, especially those institutions that are receiving research support by a grant or a contract.

The study is designed to locate undergraduate college physics departments where research is being done and to request information from the head of each of these departments concerning the research activity, its sponsorship, and some of the effects of the work on the researcher, the students, and the school. A post card questionnaire was sent to each of the 346 physics departments in the United States listed by the American Institute of Physics as offering a major only on the baccalaureate level. An eight page questionnaire was sent to each of the 108 department heads who responded that research was being done to some extent in their departments, and a six page questionnaire was sent to a random sample of 60 colleges that stated that there was no research activity in their physics departments.

The responses to the questionnaires are arranged to form a composite picture of the undergraduate college physics department. Research and its sponsorship are also fitted into the total picture. Some effects of research on students, faculty, and the college are listed, as are the reasons that urge teachers also to be researchers, the drawbacks of sponsored research, some of the agencies that sponsor research in these undergraduate colleges with a short description of the program of a few agencies, and suggestions of ways that research may be initiated or stimulated in undergraduate college physics departments.

It is concluded that meaningful research is being done in about one-third of the undergraduate college physics departments; much of it has desirable effects on students, the researcher, and the school.

A few contributions to the students include job opportunities as research assistants, equipment in the laboratory experiences, work on individual projects related to the main research problem, and prestige in presenting papers which result from the research experience. The researcher benefits by his activity which keeps him abreast with developments in at least a segment of physics, by the personal satisfaction that comes through work in helping advance the frontiers of knowledge, and by the experience, extra income, and prestige which result from research work, particularly that which is sponsored. Benefits to the school include the extra equipment that a grant or contract may bring and the obtaining and holding of men who are scholarly as well as good teachers.

Quite often the research activity is designed to include student participation. Furthermore, new research programs are being encouraged by the example of those already active in research and by grants and contracts from sponsoring agencies; sponsorship being considered necessary to maintain the present research output as well as to begin new programs.

Still unsolved is the perennial problem of whether teaching is helped or hindered when the teacher also participates in research work, although many respondents seemed to believe that the teaching was strengthened when coupled with some research activity.

Microfilm $2.75; Xerox $8.20. 180 pages.

AN EVALUATIVE ANALYSIS OF MISSISSIPPI'S PROGRAM FOR FINANCING PUBLIC ELEMENTARY AND SECONDARY EDUCATION

(L. C. Card No. Mic 61-1290)

Ira Cook Mayfield, Jr., Ed.D.
The Florida State University, 1961

The purpose of this study is to make an evaluative analysis of statutory provisions for financing public elementary and secondary education in Mississippi. The problem of the study, stated more specifically, is an attempt to answer three questions:

1. To what extent does the state's Minimum Education Program enacted in 1953 and subsequently amended, conform to the objectives enumerated by lay, professional, and legislative proponents of the Minimum Program Law?
2. To what extent do statutory provisions of the Program comply with acceptable evaluative criteria?
3. Based upon results obtained through application of acceptable evaluative criteria to selected local school units: (a) to what extent do the rejected recommendations of the Recess Education Committee impair the effectiveness and adequacy of the Minimum Program; (b) what changes in the Minimum Program Law seem warranted; and (c) what areas warrant further study and investigation?

The study embraces eleven major and two minor local administrative school units selected arbitrarily so as to be representative in several respects of the entire state. Preliminary to making the evaluation, statutory provisions on which the Minimum Education Program is founded were listed and summarized briefly. Also, a detailed application of statutory provisions as they related to the selected local administrative units in 1958-59 was made.

Data were collected from various sources, compiled, and presented in tables and charts. All procedures and computations employed in determining the amount of local and state funds necessary to support the Minimum Education Program in each selected local administrative unit for 1958-59 were described in detail.

Based upon results obtained in the detailed application, statutory provisions were evaluated in terms of the criteria, "Characteristics of a Satisfactory Program" as they appear in the volume, Problems and Issues in Public School Finance, edited by R. L. Johns and E. L. Morphet.

The study presents areas of the program which warrant changes or additional study, and in certain specific areas makes recommendations as to what the changes should be. Among the recommended changes are:

1. Additional funds should be provided for extending approved phases of the program beyond the present nine months' term.
2. Additional funds should be provided for teachers' salaries, "other costs," and capital outlay and debt service.
3. Kindergartens should be provided for immediately upon availability of funds.
4. Provision should be made for administrative and special instruction service units.
5. All educational services for exceptional children should be provided for in the Minimum Program and should be more clearly defined by statute.
6. County administration funds should be apportioned on the basis of the county superintendent's salary and for "other costs" an amount proportional to the number of allowable teacher units within the county.
7. All local administrative units should be made fiscally independent.
8. Local administrative units' taxing power should be liberalized.
9. State funds requiring separate administration should be consolidated into one education fund.
10. Transportation units should be computed on the basis of area served and the average daily attendance of pupils transported.
11. Statutes relating to the local and state partnership financing plan should be modified.
12. Agricultural high school units should be incorporated into existing county school systems.

Microfilm $2.75; Xerox $7.80. 169 pages.

EFFECTS OF TAX ELASTICITIES ON THE FINANCIAL SUPPORT OF EDUCATION

(L. C. Card No. Mic 61-1645)

Eugene Peter McLoone, Ph.D.
University of Illinois, 1961

Adequate financing of education is only a small part of two broader problems: (1) providing equal educational opportunity for all children, and (2) equalizing the tax burden not only for education but also for all governmental services. Many facets of these problems need consideration. Stability and flexibility are two qualities, among others, which a revenue system for education ought to have in order to provide adequate support. This study evaluates these qualities by analyzing and computing the elasticity of tax yield and the elasticity of educational support. This measures the responsiveness of these variables to income fluctuations. The results of these computations, in the framework of state-local finance programs and revenue needs provide implications in choosing among alternatives to assure adequate revenue in the decade of the 1960's.

The responsiveness of the revenue yield of taxes has often been overlooked. In addition, there is disagreement about the responsiveness of the major source of educational revenue, the property tax. This disagreement leads to opposing views about (1) the desirable taxes for state and local governments, and (2) the ability of state and local government to finance needed services. While the elasticity of a tax, the responsiveness of the tax yield to income fluctuations, is of concern in providing revenue for all governmental services, this study concentrates on the financing of public elementary and secondary education.

Chapter I provides an introduction to the problem. Chapter II presents the income elasticity of education, a measure of the responsiveness of educational support to income fluctuations. Chapter III examines the effective rate and the elasticity of the property tax. On a nationwide basis, the effective rate, while low, has been gradually rising during the 1950's, and approaches the rate of 1927, the highest property tax rate during a period of prosperity. The elasticity of the property tax has varied widely. Implications for future financing are derived in Chapter IV from the date in Chapters II and III plus a summarization of projections of school revenue needs. Chapter V summarizes the study.

While the income elasticity of education is similar among states for any time period, they are distinctly different among time periods corresponding to the time periods when the elasticity of the property tax base varied. The period from 1920-30 to 1957-58 is studied. Both elasticities are below 1.0 in the 1930's and both exceed 1.0 in the 1950's.

Although all the major tax sources--income, property, and sales--are elastic, there is a difference in their projected elasticity. Thus, while states can choose the degree of elasticity for the educational revenue structure, they cannot choose an inelastic revenue structure. This means that stability of revenue can only be achieved to a limited degree.

Adequate support for schools in the 1960's requires revenue sources with an elasticity greater than 1.0. Thus, flexibility of revenue is more important than stability for the period ahead. The future needs indicate that states must examine and select additional revenue sources. In the past preferences for education were achieved by changes in tax rates, bases, and sources in response to underlying economic conditions. In the future, these preferences will have to be made in the same manner. This study presents a framework in which choices of revenue sources can be made.

The elasticities of various taxes cannot be ignored in the long-range planning for revenue sources. An understanding

of these characteristics is necessary if education is to be financed adequately and equitably.

Microfilm $2.75; Xerox $7.60. 161 pages.

SOCIAL CLASS AND EDUCATIONAL ATTITUDES: A STUDY OF THEIR RELATIONSHIP AND OF THE SOCIAL COMPOSITION OF BOARDS OF EDUCATION IN MICHIGAN CITIES ABOVE 10,000 POPULATION.

(L. C. Card No. Mic 61-1766)

Calvin Bruce Michael, Ph.D.
University of Michigan, 1961

Principally, this investigation's purpose was to determine whether working class and middle class opinion leaders held significantly different attitudes toward certain educational issues and whether either group's attitudes differed significantly from those of middle class school board members. It also included a study of the social composition of school boards in sixty-three Michigan cities. The investigation's importance derived from the accumulation of school board status studies predicated on the a priori assumption that social classes differ in their attitudes toward education.

Attitudes were determined in interviews of sixty opinion leaders and thirty board members. Opinion leaders were defined as community leaders whose occupations were either middle class or working class or as heads of middle class or working class formal groups. Five opinion leaders in each social class were selected in each of six Michigan cities. Thirty members from twenty-two boards of education were randomly chosen from the middle class participants in a mailed-questionnaire study of the boards of the sixty-nine school districts located within the sixty-three Michigan cities above 10,000 population.

The findings of the attitude study revealed no significant differences between middle class and working class opinion leaders--or between either group and board members--regarding the school's purposes; the curriculum; high school drop outs; certain kinds of expenditure; or specific practices in teaching methods, pupil promotion, reporting to parents, and discipline.

In seventy-eight separate tests for significantly different responses among any two groups of respondents, sixty-one were not significant at the .05 level of significance. These findings were not altered by re-classification of the interviewees in social classes based on their self-identifications rather than occupations.

Middle class and working class opinion leaders differed significantly on seven issues; only four were polar differences. The workers approved of federal aid for school construction, and teacher strikes over unjust dismissal; they disapproved of merit rating for salaries and of competition in school work among children. The middle class group had opposite views. Differing in degree, both groups favored local purchasing by school boards and equal pay for men and women teachers; they opposed wage strikes by teachers. Middle class board members also opposed the last item although significantly more so than the working class opinion leaders. Board members also had a polar, significant difference from the favorable view the workers took of teachers' strikes over unjust dismissal.

There were five instances of significant difference in the responses of middle class opinion leaders and school board members. One was polar--federal aid for buildings; the others were differences in the degree of approval of equal pay for men and women teachers, merit rating, and local purchasing by the school board and the importance of price in determining local board spending.

The status study data approximated earlier findings. Twenty-one board members were working class; 333 were middle class, and twenty-two were indeterminate.

The principal conclusions drawn from the study were two: (1) the control of the formulation of educational policies is largely vested in persons of the same social class; (2) despite the apparent unrepresentativeness in the social composition of boards of education, there is little evidence of substantial differences in the educational attitudes of the working class and the middle class, and considerable evidence of no such differences. The a priori assumption of previous status studies is called sharply into question.

Microfilm $3.05; Xerox $10.80. 236 pages.

A COMPARISON OF THE ACADEMIC SUCCESS OF NATIVE STUDENTS AND JUNIOR COLLEGE TRANSFERS WHO GRADUATED FROM FOUR CALIFORNIA STATE COLLEGES IN 1959

(L. C. Card No. Mic 61-989)

Henry Joseph Osner, Ed.D.
University of the Pacific, 1961

The purpose of this study was to determine whether or not students who are eligible for admission to the state colleges as freshmen can be adequately prepared for upper division studies by attending junior colleges for their first two years. The academic achievement of the students as measured by their upper division grade point average was used as the measure of their success.

Two populations of students were chosen and compared. Both groups were restricted to graduates of California high schools who were eligible for admission to the state colleges on the basis of their high school grades and who graduated from Fresno, Sacramento, San Francisco, or San Jose State College in the spring of 1959. The first population included the 778 such graduates who had entered the state colleges as freshmen; the second included the 316 students who spent their first two years in one of twenty-two California public junior colleges.

Tests were made of the null hypothesis that differences between the two groups could have arisen by chance. The number of high school recommending units, upper division grade point averages, sex, major, and age were all compared for the two populations. Most of the data were summarized in terms of mean values, and the standard deviation was used as the measure of variability. Differences between means were tested for significance by the z ratio and differences in frequency distributions were tested by chi square. Values beyond the five per cent level were interpreted as being significant in the statistical sense.

It was found that the native men had a significantly larger mean number of high school recommending units than the transfer men had, 11.15 compared to 9.94, and that the upper division grade point average of 2.754 for the native men exceeded the 2.678 average of the transfer men, although this difference was not significant at the five per cent level. For the women the differences in high school recommending units and in college grade point averages were smaller and not statistically significant.

In order to control variables other than the place of lower division education, the native and transfer populations were paired with respect to college, sex, major, and number of high school recommending units. When upper division grade point averages were compared for these two paired populations, the men were found to differ only .003 grade points between native and transfers.

In addition to differences in the high school and college records of the two populations, several other differences were noted. It was observed that the women constituted a significantly smaller proportion of the transfer students than of the native students. The transfer men were found to include a higher proportion of education majors than was found among the natives. The high school and college records of both native and transfer women were superior to those of the men. The upper division grade point average of the transfer students was slightly higher than their junior college average.

It was concluded that the investigation supported the hypothesis that plans for the expansion of higher education in California can be based on the assumption that the eligible high school graduate who continues his work in a junior college will be adequately prepared for state college work. Microfilm $2.75; Xerox $8.80. 193 pages.

THE EFFECTIVENESS OF INTERNAL COMMUNICATION IN SELECTED SCHOOL SYSTEMS IN EAST TENNESSEE

(L. C. Card No. Mic 61-1483)

Ralph Martin Peters, Ed.D.
The University of Tennessee, 1960

Major Professor: Orin B. Graff

The purpose of this study was to evaluate the effectiveness of internal communication in eight public school systems in East Tennessee.

The study was concerned with determining to what extent there was mutual understanding among superintendents, principals, and teachers of four system-wide school policies. These policies pertained to: (1) solicitors and salesmen visiting teachers at school during class hours; (2) sick leave for teachers; (3) use of substitute teachers; and (4) in-service education. Data employed in measuring understanding were collected by questionnaire and interview from eight superintendents, ninety-five principals, and 644 teachers.

It was hypothesized that:

1. The understanding of a school policy was dependent on the understanding of the various aspects of that policy.
2. The understanding of a school policy varied inversely with the distance between its place of origin and its destination.
3. The understanding of policies varied in direct proportion to the size of the school system.
4. Policy information initiated in the central office of the superintendency had better access to the established channels of communication than information initiated by teachers.
5. Distortion of policy information was greater when the flow of information was through secondary channels than when it was through the primary channel of communication.
6. The understanding of school policies by teachers was proportionate to the number of years of teaching experience.

The findings of the study supported the hypotheses to the following extent:

1. Analysis of data disclosed that the understanding of school policies was not uniform. Some policies were better understood than others, and some aspects of a particular policy were better understood than other aspects of the same policy. There was at least one aspect of each policy which was better understood than the other aspects of that policy.
2. In every aspect of every policy, understanding decreased the farther school policy information traveled from the central office of the superintendency.
3. It was not established that policy understanding varied in direct proportion to the size of the school system. The understanding of policies in three large school systems, however, was found to be slightly better than the understanding in three small school systems.
4. It was found that policy information initiated by the superintendent had somewhat better access to the channels of communication than did information initiated by teachers.
5. Insofar as school policies were concerned, the individual school faculty meeting was established as the primary channel of communication. Policy information was found to be least distorted when disseminated and received through this channel.
6. The findings disclosed an increase in understanding paralleling the increase in teaching experience. The greatest increase in understanding was found to exist among those teachers with from two to six years of experience. Microfilm $3.00; Xerox $10.35. 229 pages.

AN EVALUATION OF THREE APPROACHES TO THE TEACHING OF READING

(L. C. Card No. Mic 61-1471)

Dayton G. Rothrock, Ed.D.
The University of Nebraska Teachers College, 1961

Advisers: Dr. Merle A. Stoneman
Dr. Madison Brewer
Dr. Frank Henzlik

The purpose of this study was to see if there was a significant difference in reading achievement when it was taught by a heterogeneous grouping plan, a homogeneous grouping plan, or an individualized plan. The experiment was carried out with the cooperation of the fourth- and fifth-grades of three of the four public elementary schools of McPherson, Kansas.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

The heterogeneous plan could be described as a typical developmental reading program. The homogeneous plan called for the regrouping of students by reading ability for the reading period only. The individualized reading plan called for the use of library reading material as the basic material for this program. Pupils were allowed to select their own material, proceed at their own pace, and work on areas in which they were having trouble.

Gains in reading achievement were measured by the Iowa Every-Pupil Tests of Basic Skills, Test A--Reading Comprehension, and Test B--Work-Study Skills, forms L and M. Analysis of covariance, multiple classification, was used to determine whether there had been a significant difference in gains among the approaches during the eight month period between the two tests. Adjusted means were then made for tests which showed significance at the 1% level. Previous reading achievement, intelligence, and test differences between sexes were controlled by this statistical technique. Other forms of evaluation were also used.

Four null hypotheses were formed to measure differences in reading achievement among the approaches. In the first test, Test A, fifth-grade, the hypothesis was retained. In the other three cases the hypotheses were rejected in favor of the homogeneous grouping plan which had scored a significantly higher gain as measured by the tests.

The adjusted means for the three significant scores on approaches were:

Approaches	5th-grade Test B	4th-grade Test A	4th-grade Test B
A (Heterogeneous)	6.56	5.40	5.23
B (Homogeneous)	6.94	6.02	6.00
C (Individualized)	6.69	5.66	5.60

The individualized approach scored the second largest gain among these three tests. For all the approaches the gains were favorable, generally exceeding the expected gain. It was concluded for all the approaches that above average gains could be made if proper materials and good teaching methods were used.

Other conclusions drawn from the results were that no one of the plans produced consistently better results with the first and fourth quartiles of pupils. Some ability grouping or individualization of instruction seemed to be of some help to the slower students in developing work-study skills. It was possible for individual students to make good gains under all of the approaches and it was also found that a few students failed to make a gain under all of the plans.

The group which followed the individualized approach seemed to form more favorable attitudes toward reading as measured by an attitude survey. They also appeared to do the most library reading as measured by records kept of the number of library books read.

Microfilm $2.75; Xerox $9.00. 200 pages.

PLANNING THE JUNIOR HIGH SCHOOL LIBRARY PROGRAM

(L. C. Card No. Mic 61-1473)

Silvanus Hull Sisson, Ed.D.
The University of Nebraska Teachers College, 1961

Adviser: Leslie L. Chisholm, Ph.D.

I. THE PROBLEM

The purpose of this study was to describe an adequate program of library service for the junior high school. It was intended to discover whether some junior high school library programs are superior because they possess certain elements or whether differences are merely of degree. It was proposed to identify those elements of superior libraries which inadequate library programs lack and to determine their importance to the junior high school program.

II. PROCEDURES

To determine the recognition accorded the junior high school library in state regulations, a questionnaire was sent to the fifty state departments of education.

A checklist of forty "Significant Elements Making for Adequate Library Service in the Junior High School" was prepared for the appraisal of twenty-nine selected librarians and others writing and working on school library problems.

III. FINDINGS

Only a few of the forty-eight replies from state departments of education revealed any particular attention to the junior high school library. These confined their treatment to such limited quantitative standards as the minimum size of the collection, the number of books added annually or the expenditure for them, and the professional training required of the junior high school librarian. A different basic book collection for the junior high school was often recommended from that suggested for the elementary and senior high schools.

Many of the states have one minimum professional level for all school librarians, but the majority still set or permit lesser standards for those librarians serving in the elementary and the junior high schools. Several set no standards except for the secondary school. A tendency to increase these professional standards is marked. In some cases they now include the full year of specialized training beyond the bachelor's degree.

IV. CONCLUSIONS

From the material received, there was no evidence of any planning for the "unique needs" of the junior high school library. The quantitative standards provided in state regulations for any levels of school library service are far below those now recommended nationally by the American Association of School Librarians and show little or no change in recent years to reflect the declining value of the dollar or the increased emphasis on education.

Many library programs in junior high school lack those features declared essential by the panel of expert opinion utilized in this study. The needs of any school library program are individual ones. Just as needs vary according to level, so will they differ from school to school.

Microfilm $2.75; Xerox $6.80. 142 pages.

EDUCATION, HISTORY

THE INFLUENCE OF THE SUMMER SCHOOL MOVEMENT ON THE STATE OF MICHIGAN, 1874-1931, WITH SPECIAL REFERENCE TO THE UNIVERSITY OF MICHIGAN.

(L. C. Card No. Mic 60-6865)

Jerome Anthony Fallon, Ph.D.
University of Michigan, 1960

This study traces the origins of the summer school movement and examines its early growth and development, first nationally and then in the state of Michigan. A discussion of the growth of summer educational programs in Michigan from 1880-1890, particularly that which evolved at Bay View, is followed by a detailed investigation of the impact of the summer school movement upon the University of Michigan from 1890 to 1931.

The rationale of the summer school movement is treated in a preface which contains a discussion of certain national trends and characteristics. Early chapters are designed to portray the historical antecedents of the movement, including such organizations as the Mechanics Institute, the Lyceum, and the Teachers Institute. These chapters also include careful portraits of several early summer schools and their founders. Particular emphasis is placed upon the Anderson Summer School of Biology established by Louis Agassiz and the Chautauqua Institution founded by Bishop John H. Vincent.

The summer school movement in Michigan is investigated from its first stirrings at the Bay View Assembly in 1874, and the activities of a large number of private and proprietary summer schools are traced from that time to the end of the nineteenth century. A chapter which examines in detail the summer school activities of University of Michigan faculty members from 1869 to 1890 provides insight into the difficulties experienced by University personnel upon their entrance into a variety of summer ventures.

The history of the University of Michigan Summer Session from 1890 to 1931 occupies the last half of the study. The influence of the summer school movement upon the University of Michigan is seen in the multifarious changes which took place in the University upon establishment of its Summer Session in 1894. Changes in organization and administration, in curriculum, methods, faculty and student body, budget and financial affairs, and in several other areas are examined in detail. The University of Michigan summer experience is constantly interpreted and evaluated in the light of national trends. Comparisons with the summer work of other institutions is presented to give depth and breadth to the picture.

Microfilm $4.00; Xerox $14.20. 312 pages.

A HISTORICAL ANALYSIS OF VENEZUELAN EDUCATION WITH PARTICULAR REFERENCE TO PROGRAMS OF RURAL EDUCATION

(L. C. Card No. Mic 61-1741)

Rafael González-Baquero, Ed.D.
University of Michigan, 1961

This study is divided into two parts. The first part consists of an analysis of documentary evidence relating to Venezuelan public education, 1870 to 1932. The purposes of this part are:

(a) to identify the main factors contributing to the development of public education in Venezuela;

(b) to determine the status of public education at the beginning of the programs of rural education in 1932.

The second part is concerned with the programs of rural education, 1932 to 1957, and has as its main purpose a determination of the extent to which the objectives avowed for these programs were accomplished.

The study is important since:

(a) in Venezuela there does not exist a documentary work presenting the history of education;

(b) educational officers have often failed to utilize educational experiences gained through many years;

(c) the activities of rural education were canceled in 1957 without explanation and without provision for future rural educational programs.

The analysis of documents relating to Venezuelan education from 1870 to 1932 shows that most of the activities were developed at random; with little professional guidance; with an apparent indifference toward the lack of preparation of educational personnel; and without studying the economy, means of transportation, sanitation, and other socio-physical conditions of the country. Because of these factors, primary and normal schools, by 1932, were in a chaotic state.

In 1932, the first programs of rural education were instituted. These programs had the following objectives:

(a) to instruct the rural people in health and sanitation;

(b) to prepare the country youth for higher productivity and for the sensible exploitation of natural resources;

(c) to encourage the rural population to remain in their native regions.

After 1936, new programs of rural education were begun. Three rural normal schools to prepare rural teachers were founded. More than forty model rural schools to educate children and adults and to improve their standards of living began functioning. Several mobile rural missions began operation. An experimental zone to study rural housing, rural school organization, and problems of school attendance was set up. Finally, the rural nuclei consisting of several rural schools under the direction of a supervisor were established.

The early programs of rural education encountered difficult problems: unprepared teachers and supervisors;

inadequate housing; a dearth of equipment and instructional supplies.

The rural normal schools lacked trained teaching and administrative personnel, proper housing facilities, agricultural land, sufficient water supply, adequate instructional materials.

The model rural schools, the rural missions, and the rural nuclei faced similar difficulties. The experimental program was begun without considering the conditions of the schools in the zone; the lack of preparation of the teachers; the physical condition of the region, its roads and means of transportation.

These conditions with which the rural educational programs were confronted, and which were fundamentally the same as those encountered by former school projects between 1870 and 1932, prevented the fulfillment of the objectives of the programs of rural education.

Recommendations based on findings of the dissertation include:

(a) Reorganization of the Ministry of Education to provide for integration and continuity in the national educational program;

(b) Emphasis on research and long-range planning so that new programs can be based on carefully gathered data;

(c) Reestablishment of a rural school program based on the indigeneous needs of the community;

(d) Special emphasis on the preparation of rural primary school teachers;

(e) Coordination of educational programs with the programs of other governmental agencies designed to improve living conditions in rural areas.

Microfilm $3.80; Xerox $13.30. 295 pages.

CHARACTERISTICS OF GREAT TEACHERS

(L. C. Card No. Mic 61-1954)

Neil Lamper, Ph.D.
Michigan State University, 1959

The problem in this study was to identify the characteristics of great teachers. Twelve men of the past were used as a basis for the study. They are as follows: Buddha, Confucius, Socrates, Jesus, Quintilian, Erasmus, Comenius, Pestalozzi, Froebel, Horace Mann, Mark Hopkins, and Gandhi. The purpose of the study was to identify those aspects of these twelve men that might have had bearing on their effectiveness not only as leaders but also as teachers of men.

The process used in the study was an analysis and synthesis of what is known and has been said about the twelve men selected for study. The thesis began with an acknowledgment of purpose, the background investigation of and reasons for the study. A section was then devoted to theories of social change, leadership, learning, and various known methods of teaching. The next section of the study was devoted to a consideration of the nature of research, with an emphasis on educational research employing some of the principles of historical research. Additional paragraphs dealt with the selection of the twelve men to be studied and the survey of contemporary opinion leading to this selection.

The main body of the study is a series of twelve brief sketches. These sketches deal shortly with the facts of birth, locale, and death. Some mention is made of social forces but the primary emphasis is on how the twelve men lived, and where necessary, on what they said. Lists were compiled of the outstanding characteristics of these men. A final section of the study organized the data into a meaningful pattern involving the characteristics of the twelve men studied and their implications for teaching method.

The findings of this study indicate that the personality of the teacher is quite significant. The twelve men studied lived in different social situations, had different purposes, and had different ways of organizing their knowledge. But there was a consistency in the way they expressed their knowledge and in their attitudes towards people. The study listed many personality traits in each section, but in its final pages, it dealt with only those five which were outstanding in the case of each of the twelve men, and which were broad enough to be considered categories, covering many smaller items of subtle interpretation. The following five essential categories of characteristics evolved in the study: enthusiasm, simplicity, dedication, purpose, and humility.

The recommendations of this study are that it is meaningful to note that twelve men whom history has recorded as influential all possessed these same five characteristics, plus the interpolated considerations that went into the descriptions of these five items as categories. The study recommends that these be considered some of the characteristics of great teachers. Additional recommendations are added that call for a wider exploration into the lives of other men of influence, investigations in greater depth of each of the twelve men included in this study, and any attempts that can be made to understand more fully these traits so that they might be within the understanding and possible reach of any serious student of effective teaching. Microfilm $4.30; Xerox $15.10. 334 pages.

DEVELOPMENT OF PROFESSIONAL RADIO-TELEVISION EDUCATION IN CINCINNATI, OHIO (1939-1959).

(L. C. Card No. Mic 60-6157)

Joseph F. Link, Jr., Ed.D.
University of Cincinnati Teachers College, 1960

Statement of the Problem: The purpose of this dissertation is to present an accurate account of the origin and development of professional courses in radio and television on the college level in the Cincinnati area and particularly as developed by the College of Music of Cincinnati, Ohio.

Significance and Value of the Study: This study has major importance in that radio-television education, known today as "Communication Arts," has been accepted as an accredited field of study in many American colleges. The College of Music was a pioneer in beginning such courses and in acquiring accreditation for them from

the Department of Education, State of Ohio. The experimental practices and procedures by the College of Music serve as a pattern for other accredited colleges. It is of further value in that it includes the study of radio and television education in other liberal arts colleges within a hundred-mile radius of Cincinnati and traces the development of WCET, Cincinnati's Educational Television Station. The College of Music was the first college in the State of Ohio to grant a Bachelor's degree in Radio-Television Education and WCET was the first permanently licensed educational television station in America by the Federal Communications Commission.

Summary: Cincinnati, as a musical, educational, and broadcasting center, provided the cultural climate and educational environment for the origin and growth of college courses in radio-television education by a music school. The first course in radio for college students was given by the College of Music in 1936 for 30 music students on scholarships provided by WLW in Cincinnati, Ohio. The courses and enrollment grew until 1944 when four colleges of the University of Cincinnati -- Home Economics, Teachers' College, College of Engineering and Commerce and College of Liberal Arts -- accepted selected radio courses for credit toward degrees on that campus. On October 21, 1946 the College of Music was granted authority to award the Bachelor of Fine Arts degree in Radio-Television Education by the Department of Education, State of Ohio. The College then offered a two-year Certificate Program and a four-year Degree Program in Radio and Television. A Liberal Arts core of studies was introduced, 128 semester hours required for the BFA degree and a maximum of 88 semester hours in liberal arts subjects was offered.

In 1954 a laboratory program was begun which provided students with practical experience in working in the educational and commercial radio and television stations for credit under professional supervision. In 1954 the Graduate School of Xavier University accepted 12 professional credit hours from the College of Music in radio-television subjects toward its Master of Education program and the following year 18 semester hours in this field were accepted by Xavier University as a minor in its B.S. program in English.

WCET, Cincinnati's community owned educational television station began operation in 1954. The director of the Radio-Television Arts department of the College of Music became the first general manager of the station and three faculty members formed the nucleus of the professional staff at WCET. The television studies and facilities of the College of Music became the home studies and offices for WCET.

Conclusions. The area of "Communication Arts" today is becoming a major field of study. The radio and television industry demand more and better trained liberal arts graduates with an opportunity to major in script writing, radio-TV speech and announcing, radio-TV production and direction, Acting and Engineering. Specific recommendations in the thesis were made as follows: The area of Communication Arts in college should include studies commonly known as Drama, Speech, Radio-Television, Journalism and Public Relations. This work during the organizational years could be under the English, Speech, Drama or other departments. Provision should be made today for a two-year Associate Degree program of 70 semester hours to provide for terminal vocational training in this field and a four-year Bachelor's degree program. This program of 128 semester hours should include at least 60 semester hours of the traditional Liberal Arts core – English, Science, Mathematics, History, Economics, Language and Philosophy-Theology. The equipment and facilities of local commercial radio and television stations may be used for laboratory and classrooms to begin the program and the local stations may provide part-time professional teachers. An effective laboratory or on-the-job workshop type of program must be established in this field to provide the student with experience in radio and television station operation and this experience should provide credit the same as practice teaching, accounting and science laboratories.

Every effort should be made to promote and encourage the establishment and operation of an educational radio or television station in the community or under direct auspices of the college on its own campus.

Colleges must produce effective thinkers, writers and speakers today if our democratic society and institutions are to live and progress in the propaganda war of the battle for men's minds. The study of Communication Arts will enable us to communicate with the peoples and races of the world effectively in order to bring them the message of peace, security, democracy and truth.

Microfilm $6.50; Xerox $23.20. 511 pages.

EDUCATION, PHYSICAL

THE WORK REQUIRED TO PRODUCE CHANGES IN CARDIOVASCULAR FITNESS

(L. C. Card No. Mic 61-1913)

Harry Ketchum Campney, Jr., Ph.D.
State University of Iowa, 1961

Chairman: Associate Professor Arthur J. Wendler

The purpose of this study was to determine, for a selected group of college men exhibiting symptoms of low-level cardiovascular fitness, the amount of metabolic work required to produce changes connoting improvement of that aspect of cardiovascular fitness measured by heart-rate recovery.

The subjects, eight college men, were selected from students who had enrolled in the service courses in physical education at the State University of Iowa, but who had not participated in any physical activity in these classes. Each man volunteered his services for the experiment and met several limiting criteria designed to classify each subject in terms of low-level cardiovascular fitness.

Each subject exercised by stepping from the floor to a bench seventeen inches high at the rate of thirty steps per

minute. With the exceptions of the tenth, the twentieth, and the twenty-first exercise bouts which were limited in duration to the time of the first exercise bout, the duration of each exercise bout demanded an "all-out" performance. Twenty exercise sessions were equally spaced over a period of ten weeks and were followed by a five-week detraining period. The twenty-first exercise session occurred during the fifth week of detraining.

The data that were collected included resting and recovery heart-rates; times of rest, exercise, and recovery; resting, exercise, and recovery oxygen-consumption volumes; room and spirometer temperatures; and barometric pressures. All the oxygen consumption values were obtained with a Collins' (13 1/2-liter) respirometer. The heart-rates were obtained with a short-range telemetering device that was employed as a cardiotachometer. The recording of the heart-rate in graphic form involved the use of a transistorized transmitter, a Heathkit FM4 tuner, and a type 542 Offner dynograph amplifier-recorder.

Measures of heart-rate-recovery time, rate of heart-rate recovery, and the percent of heart-rate recovery were employed to observe the changes in heart-rate recoveries. The oxygen consumption values were employed to determine the net energy cost of the work performed by each subject in terms of caloric units.

For seven of the subjects, when the durations of the bouts of exercise were held constant, changes that connote improvement of that aspect of cardiovascular fitness that is measured by heart-rate recovery were observed during the first five weeks of the training period. The heart-rate recovery patterns of the eighth subject during this same period were, because of incomplete data, not observable. During the second five weeks of the training period, when the durations of the bouts of exercise were held constant, six of the subjects failed to exhibit a continued improvement in any of the three heart-rate recovery measurements. However, two of the subjects exhibited improvements in heart-rate recovery during the second five weeks of the training period.

For all the subjects the duration of the bouts of exercise progressively increased during the ten-week training period.

For the exercise sessions in which the durations of the bouts of exercise were not held constant, seven of the subjects exhibited improvements in the average rate of heart-rate recovery during the ten-week training period. No change in the average rate of heart-rate recovery was observable for the eighth subject. Also, when the durations of the exercise bouts were varied, five of the subjects showed improvement in the percent of heart-rate recovery throughout the training period, one of the subjects exhibited a loss, and the two other subjects showed no change.

The net energy cost of the work required to produce the changes in heart-rate recoveries ranged from 703.29 Cal. to 1623.19 Cal. The wide range of the total caloric cost corresponds to the wide range of the total time for the exercise bouts.

Microfilm $2.75; Xerox $7.40. 160 pages.

THE RELATIONSHIP BETWEEN SELECTED MEASURES OF EXPRESSIVE LANGUAGE AND MOTOR SKILL IN EIGHT-YEAR-OLD BOYS

(L. C. Card No. Mic 61-1936)

Ann Lee Sprague, Ph.D.
State University of Iowa, 1961

Co-chairmen: Dr. M. Gladys Scott
Dr. Frederic L. Darley

The major purpose of this investigation was to determine the relationships between selected measures of expressive language and motor skill, and between these and certain physical, intelligence, and socio-economic measures in eight-year-old male subjects. A second purpose was to describe the performance of eight-year-old boys on selected measures of expressive language and motor skill.

Sixty-two boys between the ages of 7-10 and 8-2 years were selected from among all eight-year-old boys currently enrolled in Iowa City elementary schools during the fall of 1959. The mean chronological age of the subjects was 95.5 months. The sample was restricted to physically normal, white children with siblings, from monolingual homes, considered to be normal in intelligence (an IQ of 80 or above) and found to have normal hearing.

Tests were administered to individual subjects in two sessions at the school of attendance as follows: Session I - height, weight, and shuttle run, repeated wall throw, stick balance, modified Minnesota Rate of Manipulation, and standing broad jump tests; Session II - audiometer sweep-check test of hearing, Ammons Full-Range Picture Vocabulary Test, Templin 50-item Screening Test of Articulation, elicitation of the connected speech sample, and four measures of oral diadochokinesis.

A descriptive and intercorrelational analysis of the results for 62 eight-year-old male subjects on 10 measures of expressive language skill, seven measures of motor skill, and four control measures indicate the following conclusions are justified: 1) In general, the measures of expressive language and motor skill studied in this investigation are not significantly related. However, there are certain notable exceptions which would appear to warrant further study. Relationships statistically significant at the 5 percent level were found to exist between two manipulation measures of "fine" motor coordination and six expressive language skills: three which measure verbalization and three which measure oral diadochokinesis. The highest correlations (significant beyond the 1 percent level) were obtained between measures of oral diadochokinetic rate and manipulation. (2) Motor skill measures, generally, show interrelationships significant at the 5 percent level; however, higher relationships are noted between the skills which are similar in range and quality of movement. None of the interrelationships is of sufficient magnitude to warrant substitution of one measure for another or the use of any single measure as an index of general motor performance. 3) Relationships between the various expressive language skills are, generally, restricted to those measuring the same type of ability. These interrelationships are quite high and positive with the exception of expected negative relationships between number of one-word responses and two measures of verbalization. The

measures of expressive language used in this study are more highly related to each other than are the motor skill measures. However, the lack of relationship between certain measures prohibits the substitution of one measure for another, or the use of any single measure as an index of language development. 4) Boys between the ages of 7-10 and 8-2 years show differing amounts of variability of performance depending on the skill being tested. Certain expressive language and motor skills appear to be uniformly developed in all boys by eight years. 5) Intelligence and socio-economic status have no apparent relationship to the performance of "gross" motor skills but are positively related to "fine" motor coordinations. 6) Intelligence is positively related to certain qualitative and quantitative measures of verbalization and to oral diadochokinetic rate. Socio-economic status is positively related to the level of articulatory skill and to oral diadochokinesis. 7) Height and weight are highly related in eight-year-old boys. Weight appears to be less influenced by chronological age than is height.

It is to be hoped that those who work with children will benefit from the findings of this study by a broader knowledge of the levels of performance which can be expected of eight-year-old boys in expressive language and motor skills; that there will be an increased awareness that teaching and guidance of children is the mutual concern of teachers of physical education and of classroom teachers; and that measures of speech and motor skill may be diagnostic for the detection and possible solution of some common problems of neuromuscular coordination.

Microfilm $2.75; Xerox $9.45. 210 pages.

EDUCATION, PSYCHOLOGY

THE EFFECTS OF TESTING AND TWO METHODS OF TEST INTERPRETATION ON SELECTED SELF-PERCEPTIONS

(L. C. Card No. Mic 61-1588)

Edward George Adamek, Jr., Ed.D.
University of Illinois, 1961

Despite differences among counselors, there is agreement that counseling should elicit counselee changes in self-perceptions. One method used is the introduction of self-information through testing and test interpretation on the assumption that the counselee will learn more accurate information about himself. In many cases, however, self-information is not learned because of unconscious resistance or other causes.

Little is known about the impact of testing itself on self-perceptions. In public schools, mass testing and test interpretation procedures have been introduced because of inadequate numbers of qualified counselors, routine work, and insufficient money. Media for self-interpretations of test information have been developed by test publishers despite cautions expressed by professional guidance and psychological organizations. The efficacy of such media has undergone little study.

The present study was concerned with the effects on self-perceptions of testing, and of two methods of test interpretation, self-interpreting materials versus counselor interpretations.

Methodology

Two approaches were included: (1) comparative changes of self-perceptions after testing and test interpretations were studied; (2) accuracies of self-perceptions before and after testing, and after differentiated test interpretations were analyzed. A self-rating scale to measure self-perceptions regarding relative positions on selected interest, ability, and problem areas was developed.

Two groups of freshmen in a large suburban high school served as subjects. A control group (81) completed the self-rating scale at three specified time intervals. An experimental group (103) was administered a test battery consisting of the Kuder Preference Record, PMA, and SRA Youth Inventory between completions of the rating scale. Experimental subjects were then randomly placed into one of the two test interpretation groups. They completed the scale a third time immediately after test interpretation.

Subjects' initial and subsequent self-rating categories were compared to obtain numbers with changed ratings. Accuracy was checked by comparing test percentile rank and self-rating categories. Hypotheses were tested by chi-square techniques.

Conclusions and Implications

Interpretation of results led to the conclusions that (1) some changed perceptions could be attributed to testing, but few could be accounted for by test interpretations; (2) on most selected dimensions, systematic changed perceptions did not occur over intervening testing and test interpretations; (3) testing did not induce more accurate self-perceptions; (4) use of self-interpreting materials did not elicit more accurate self-perceptions; (5) no systematic differences revealed the superiority of one type of test interpretation over the other; and (6) neither group improved self-understanding much, but all changes that occurred were in favor of individual interpretations by a competent counselor. Perhaps pupils understand themselves fairly well before testing and/or test interpretation and don't need this help. This might be true for enough to make it nearly impossible to obtain significant results. Perhaps we can help pupils increase accuracy of self-perceptions only when they recognize need for information. These speculations raise serious questions about requiring everyone to take tests--or, at least, about requiring them to have tests interpreted.

Microfilm $2.75; Xerox $6.80. 141 pages.

THE EFFECT OF DIFFERENT DEGREES OF TENSION UPON THE QUALITY OF PERFORMANCE OF COLLEGE STUDENTS ON A SUBJECT MATTER ACHIEVEMENT TEST

(L. C. Card No. Mic 61-1828)

William Edward Baldwin, Ed.D.
University of Arizona, 1961

Director: Dr. Curtis B. Merritt

THE PROBLEM

A matched group experiment was performed with eighty-seven college students to determine: (1) if differences in mean achievement test performance would result when three equated groups were each subjected to a different level of psychological tension (maximum, medium, and minimum); (2) if susceptibility to situational psychological tension was related to scores on a test of general anxiety; (3) if high anxious subjects differed from low anxious subjects in test performance under conditions of psychological tension; and (4) if high anxious subjects differed from low anxious subjects in test performance under conditions where no tension-arousing stimuli were imposed.

METHOD

The three groups of students were equated on L-scores of the ACE Psychological Examination, previous test scores in a college psychology class, pulse rate, amount of downward pressure exerted while writing on a test paper (called carbon-pressure score), and a measure of psychological tension developed by this writer for use in the experiment and called the Affective Involvement Scale (AIS).

Each group was subjected to a different level of tension-inducing stimuli. Members of the group exposed to the maximum tension-stimulus were told that their scores on an unexpected test would replace the scores they had earned on a previous test, the reason being given that some of the members of the class had had previous knowledge of the questions on the test. Members of the group exposed to the medium level of tension were told that the test scores they would earn would be added to their scores on the previous test. Members of the group exposed to the minimum tension-stimulus were told that the score they would earn would not be counted on their grades.

FINDINGS

1. No significant differences were found between the mean achievement test scores of any of the groups.
2. No significant differences in mean pulse rate and carbon-pressure scores were found between any of the groups.
3. Significant differences were found in AIS scores between groups subjected to tension-inducing instructions (maximum and medium) and the group not subjected to the tension-inducing instructions.
4. No significant relationship was found between scores on the measures of tension (pulse rate, carbon-pressure, and AIS) and scores on the Taylor MAS.
5. No significant differences in test performance were found between high and low anxious students (as indicated by scores on the MAS) in the two groups subjected to the tension-inducing stimuli.
6. No significant differences in test performance were found between high and low anxious subjects in the groups not subjected to the tension-inducing stimuli.

CONCLUSIONS

The findings, while applicable to the specific situation in which they occurred, seemed to justify the following conclusions:

1. The psychological tension produced in a regular college testing situation is not ordinarily sufficient to have an adverse effect on the students' test performance.
2. Psychological tension produced as a result of exposure to an unexpected test is found just as frequently in low anxious subjects as in high anxious subjects.
3. Psychological tension occurs as a first response to a subject matter testing situation but is not necessarily accompanied by physiological involvement of pulse and muscular tension.

Microfilm $2.80; Xerox $9.70. 214 pages.

A STUDY OF THE RELATIONSHIP BETWEEN PARENTAL ACCEPTANCE AND THE ACADEMIC ACHIEVEMENT OF ADOLESCENTS

(L. C. Card No. Mic 60-6431)

Janice Marie Barwick, Ed.D.
Boston University School of Education, 1960

Problem

The purpose of this study was to determine whether there is a significant relationship between parental acceptance as perceived by both parents and children and the academic achievement of the latter.

Procedure

1. The pupils enrolled in Grade 8 at the William Pollard Junior High School in Needham, Massachusetts provided the population from which the sample of this study was selected. The group was classified into high-, average-, and low-achievers on the basis of the difference between the actual and predicted grade-point indices. High- and low-achievers were identified on the basis of grade-point indices one standard error of estimate above or below the predicted value. The predicted grade-point

index was found by means of a regression equation, using an intelligence quotient obtained from the Otis Beta Group Intelligence Test as the prediction variable. The grades received at the termination of the first semester of Grade 8 were used to compute the actual grade-point index. This procedure resulted in 47 high-achievers, 226 average-achievers, and 37 low-achievers. From each of these groups 15 boys and 15 girls were selected according to the method of random numbers, resulting in 30 students at each level. Those students and their parents comprised the sample population.

2. The instruments used to measure the children's perception of parental acceptance were: Whitesel's Situation Questionnaire for Parent-Child Relationships, Gilmore's Sentence Completion Test, and the TAT. The Porter Parental Acceptance Scale was used to obtain data concerning the parents' perception of their acceptance of their children.

3. Each of the tests yielded three scores: Mother-Acceptance, Father-Acceptance, and total Parent-Acceptance Scores. The data were subjected to an analysis of variance and the results of each test were treated separately. The level of significance chosen was the five per cent level.

RESULTS AND CONCLUSIONS

The results reported are based on the trends indicated by mean values, on the assumption that trends in mean values of the mother- and father-acceptance scores for the three groups of achievers would indicate that a relationship exists between parental acceptance and academic achievement. Wherever trends are supported by significant F-ratios, the names of the tests yielding the significant F-ratios and the levels of significance are indicated.

1. Boys achieving at a higher level reported fathers as more accepting than did those achieving at a lower level.
   a. The decrease in father acceptance was greater from the average- to low-achieving level than from high- to average-achieving level.
2. Mothers were perceived as least accepting by the high-achieving boys and as most accepting by the average-achieving boys.
   a. This increase in mother acceptance with a decrease in father acceptance as the level of achievement became lower may be inferred as an attempt by the mothers of lower achieving boys to compensate for the decrease in father acceptance.
3. a. High-achieving boys perceived mothers and fathers as equally accepting.
   b. Average-achieving boys perceived mothers as more accepting than they did their fathers. (TAT-five per cent level)
   c. Low-achieving boys perceived mothers as more accepting than they did their fathers. (Situation Questionnaire-one per cent level)
4. Mother acceptance as perceived by the girls increased as the level of achievement became higher.
5. Father acceptance as perceived by the girls increased as the level of achievement became higher. (TAT-five per cent level)
6. Mother acceptance was perceived by the girls at all levels as greater than father acceptance. (Situation Questionnaire-five per cent level for both high- and average-achieving girls)
7. In general, the parents' report of their own attitudes did not agree with their children's perception of them. However, it is felt that the child's perception is a stronger factor in achievement motivation than the actual stimulus or the parental report of it.

LIMITATIONS

1. Errors inherent in the subjective interpretation and scoring of the projective tests.
2. Error of measurement resulting from using an intelligence quotient as the single prediction variable in predicting grade-point index.
3. The small size of the sub-groups of the sample population.
4. The sample population is not representative of the total population. (I. Q. Range: 109-116)

Microfilm $2.75; Xerox $7.00. 147 pages.

A COMPARATIVE STUDY OF INTELLECTUALLY GIFTED AND INTELLECTUALLY AVERAGE CHILDREN IN A PROBLEM-SOLVING SITUATION

(L. C. Card No. Mic 61-500)

Elliott Donald Blodgett, Ed.D.
Syracuse University, 1960

The purpose of this study was to explore and compare selected factors which contributed to an understanding of how a subject arrived at the solution to a problem. The major area of emphasis concerned the process utilized in achieving a given solution.

Three groups of subjects were employed. They were matched for mental age and chronological age, and reflected similar socio-economic backgrounds. The subjects were presented with three tasks: the Modified Hanfman-Kasanin Test of Concept Formation, the Wisconsin Card Sorting Test, and the Porteus Mazes. Subjects' performance with reference to the concept formation task were examined as a function of time required for solution, number of questions asked, amount of information gathered, average rate of acquisition of information, proportion of work accomplished within a given proportional time, type of approach, and predominant mode of inquiry. The Wisconsin Card Sorting Test purported to measure a flexibility factor. The Porteus Maze test was designed to reflect stereotypy.

Statistical procedures utilized included the t-test for independent means, the Snedecor F-test for homogeneity of variance, and a simple analysis of variance design.

The results between chronologically comparable age groups for the variable of time favored the gifted group. No statistically significant differences were observed between these two groups on the remaining variables though the gifted subjects appeared to exhibit a generally more adequate performance. The two groups matched for mental age showed no statistically significant differences, even for time taken to complete the task. The latter finding would seem to lend credence to a mental age score as continuing to be an important piece of educational information. Microfilm $2.75; Xerox $6.40. 135 pages.

SECURITY IN VOCATIONAL CHOICE: A STUDY OF MALE COLLEGE UPPERCLASSMEN.

(L. C. Card No. Mic 60-5083)

Stuart Hollander Blum, Ph.D.
Columbia University, 1960

Chairman: Robert L. Thorndike

Investigation has been conducted by workers of many disciplines in attempting to determine the manner in which various factors are related to vocational choice. One of the often mentioned, but less investigated, of these factors is the desire for security. It was the purpose of the present study to ascertain differences among individuals with respect to the degree of importance placed upon a desire for security as a factor in vocational choice, and to determine how this degree of emphasis is related to other pertinent characteristics or variables of the individual. Whereas any measure of security or insecurity is probably a reflection of a deeper psychological security, for purposes of the present investigation the deeper psychological aspects were largely treated as measurable normal personality variables. The areas for investigation were based on the expectation that:

1. Degree of emphasis placed upon security as a factor in vocational choice exists as a trait of some comprehensiveness that can be measured reliably.
2. A positive relationship exists between emphasis upon security in vocational choice and the actual indication of a job situation of a secure type.
3. Significant relationships exist between emphasis upon security in vocational choice and normal personality variables as measured by the Edwards Personal Preference Schedule.
4. Significant relationships exist between emphasis upon security in vocational choice and background factors.

Inasmuch as an instrument to measure the degree of emphasis placed upon security in vocational choice was not available that met the desired specifications of the present study, a forty item inventory was developed. The degree of emphasis placed upon security in vocational choice was thus operationally defined as the score obtained on the inventory. On the basis of a sample of 404 male college Juniors and Seniors, a mean of 13.6 and a standard deviation of 6.0 were obtained for the final form of this Security Inventory. The reliability as estimated by Kuder-Richardson Formula #20 was found to be .82. A twenty-four item questionnaire was devised to ascertain background information and the indication of the actual job situation desired by the individual. The complete set of instruments was administered to 513 students enrolled in the following institutions: The City College (New York), Fairleigh Dickinson University, Colgate University, Buffalo University, and Columbia University. Of this number, 404 students met the qualifications of bona fide male upperclassmen (Juniors and Seniors), and 346 of these upperclassmen completed all materials for an 86% return. Raw scores (the total number of "security alternatives" chosen) on the Security Inventory and the raw scores on the Edwards Personal Preference Schedule were correlated. Wherever possible, the items of the Biographical Information questionnaire were coded so as to make possible product-moment correlations with the raw scores of the Security Inventory. Analysis of variance procedures were utilized where correlational analysis was not feasible.

The hypothesized expectations were confirmed. It was concluded that, for college upperclassmen, at least, emphasis upon a desire for security in choosing a job or an occupation exists as a trait of some comprehensiveness that can be measured reliably, and that it is characterized by low, but statistically significant correlations with personality and background variables. The personality variables in the EPPS most closely associated with a desire for security in vocational choice, are a desire for Order and an avoidance of Change. Using both the general expectation and the ten-year goal as indications of anticipated job situation, progressively higher security score means were found to be associated with progressively larger and generally more secure employers. Security score was found to be significantly related to field of major study in college. Microfilm $2.75; Xerox $4.20. 80 pages.

GRADUATE INSTITUTIONAL IDENTIFICATION AND THE ROLE CONCEPTS OF SECONDARY SCHOOL COUNSELORS

(L. C. Card No. Mic 60-6802)

Edwin Ainsworth DuBois, Jr., Ed.D.
University of Missouri, 1960

Supervisor: Paul C. Polmantier

PURPOSE: To assess and compare role concepts of secondary school counselors by grouping these counselors according to institutional identification of professional guidance preparation; and to compare the role concepts of these groups with those of the counselor group studied by Schmidt.

METHOD OF RESEARCH: A Q-sort of fifty statements concerning school counselor functions was administered to all counselors participating in the study.

Counselors were selected for the study by examining a current listing of Missouri public school guidance workers. The criteria for selection provided that the counselors were among those holding either the

Professional or the Teacher-Counselor Certificate, were employed in a public secondary school, had one hour or more per day assigned to guidance duties, did not have a title indicating administrative duties, did not participate in a study conducted by Schmidt, did not participate in the Counseling and Guidance Training Institute, Summer Session, 1959, University of Missouri, and had not completed professional guidance preparation prior to 1945.

Four counselor groups were established according to training institution background. Group "A," (N = 19), was composed of counselors who received their guidance preparation at a university in Missouri; Group "B," (N = 10), had counselors who received their guidance preparation at a State college in Missouri; Group "C," (N = 19), was composed of counselors who obtained their guidance preparation at various colleges and universities in the United States. Group "D," (N = 19), had counselors who obtained their guidance preparation at a university in Missouri.

A personal visit with each counselor was made and he was asked to sort the fifty items (1) according to the way he actually sees his role as a counselor; and (2) according to the way he would ideally like to see his role as a counselor. The method of analysis of the data was that of correlation.

SUMMARY:

(1) The relationship between the actual and the ideal role concepts for each of the counselors was determined by correlation.

(2) The extent of the relationships among the four groups of counselors, with regard to role concepts, was indicated by an average r for the group. For Groups "A," "B," "C," and "D," the average r's were .730, .784, .720, and .769 respectively.

(3) A composite sort, i.e., a representative actual sort and ideal sort, was formed for each group.

(4) The comparison of role concepts of the various counselor groups revealed consistency and similarity.

(5) The average r (.747) actual-ideal for all sixty-seven counselors in this study was compared with the average r (.744) of Schmidt's counselor group. The difference between these values was not significant at the .01 level.

(6) The relationship between the composite actual sort of sixty-seven counselors in this study with the composite actual sort of forty-eight counselors in Schmidt's study was shown by a r of .924.

(7) The relationship between the composite ideal sort of sixty-seven counselors in this study with the composite ideal sort of forty-eight counselors in Schmidt's study was shown by a r of .940.

CONCLUSIONS:

(1) There is a State of Missouri image of counselor role rather than separate training institution images.

(2) The actual-ideal role concepts of the counselors in this study are similar to those of the counselors utilized in Schmidt's study.

(3) The actual role concept of counselors in this study is similar to that of the counselors involved in Schmidt's study.

(4) The ideal role concept of counselors in this study is similar to that of the counselors participating in Schmidt's study.

(5) Counselors in this study and in Schmidt's study have great similarity in the guidance functions that they highly accept and that they highly reject.

Microfilm $2.75; Xerox $6.20. 129 pages.

RELATIONSHIPS OF BEHAVIOR CHARACTERISTICS AND PEER STATUS AS INDICATORS OF PERSONALITY DEVELOPMENT

(L. C. Card No. Mic 61-1735)

Edna M. Echelberger, Ph.D.
University of Michigan, 1961

The study was proposed as a means of gaining insights into behavior characteristics which are determinants in the personality development of children of elementary school age.

Implicit in the study is the point of view that at school, as in other social environments, the child's personality development is related to his ability to meet individual needs through behavior which is socially acceptable to himself and to others in the environment. In the classroom the child is involved in an ongoing process of social interaction in which his behavior changes. Changes in the child's behavior are interrelated with the value judgments of his teacher and the value judgments of his peers.

This study proposed that an analysis of the relationships between the value judgments made by teachers and those made by children would reveal which of certain behavior characteristics selected by adults as being the major indexes of personality development are of major concern to children.

Estimates of the teachers' value judgments were secured from scores on the Haggerty-Olson-Wickman Behavior Rating Schedules. Estimates of the children's value judgments were secured from scores on near-sociometric tests.

The children in the sample consisted of 274 children in the elementary grades at the University School, Ann Arbor, Michigan.

The hypotheses were grouped under two main headings, viz., (1) association of behavior characteristics with peer status and (2) developmental trends.

Correlation and regression techniques were used to analyze the extent of association between measures which indicate teachers' evaluation of children's behavior characteristics and measures of peer status attributed to these children by their classmates. Tests were made to determine whether or not there were significant differences between the correlation coefficients of measures of behavior characteristics and measures of peer status among children in the lower grades and children in the upper grades.

Analysis of the data revealed that groups of children who are rated high for social power by their classmates

are perceived by their teachers to be using a large proportion of socially acceptable behavior as indicated by measures of (1) behavior problems, (2) behavior traits, (3) physical traits, and (4) social traits. Also, the older children who receive high peer ratings on social power are perceived by their teachers to be using a large proportion of socially acceptable behavior as indicated by measures of (1) intellectual traits and (2) emotional traits.

Groups of children who are rated high for likability by their classmates are perceived by their teachers to be using a large proportion of socially acceptable behavior as indicated by measures of (1) behavior problems, (2) behavior traits, (3) physical traits, (4) social traits, and (5) emotional traits. Also, the older children who receive high peer ratings for likability are perceived by their teachers to be using a large proportion of acceptable behavior as indicated by measures of intellectual traits.

Groups of children who receive high peer ratings for expertness are perceived by teachers to be using a large proportion of socially acceptable behavior as indicated by measures of (1) behavior traits, (2) social traits, and (3) emotional traits. The younger children who receive high peer ratings for expertness are perceived by their teachers to be using a large proportion of socially acceptable behavior as indicated by measures of (1) behavior problems and (2) physical traits; the older children who receive high peer ratings for expertness are perceived by their teachers to be using a large proportion of socially acceptable behavior as indicated by measures of intellectual traits.

Analysis of the differences between groups of younger and groups of older children reveals a closer association among older children than among younger children for measures of intellectual traits and likability. It also reveals a closer association among older children than among younger children for measures of intellectual traits and measures of expertness.

Microfilm $2.75; Xerox $6.00. 125 pages.

AN EXPLORATORY STUDY TO DETERMINE THE SIGNIFICANCE OF EARLY LONGITUDINAL RECORDS OF ABILITY AND ACHIEVEMENT AS PREDICTORS OF ACADEMIC ACHIEVEMENT IN COLLEGE

(L. C. Card No. Mic 61-1744)

Carl Herbert Haag, Ph.D.
University of Michigan, 1961

The Problem

The purpose of this study is to determine the relationship between elementary school test data and college grade point average (CGPA). The increasing numbers of students seeking admission to college makes it imperative that more be learned about the factors which are related to academic success in college and about the developmental pattern of these factors.

Procedure

The sample used in this study is made up of 97 students who attended the University Elementary School of the University of Michigan and who later enrolled in college. Scores from the Stanford Achievement Test and from the Stanford-Binet Test of Intelligence, available for most of the students for each elementary school grade, were converted to educational age (EA) and mental age (MA) units and were used to obtain the independent variables: a) slope of the EA and MA growth lines, b) the Y-intercepts of the EA and MA lines, i.e. the negative extension of the growth line to the Y axis, and c) the educational quotient (EQ) and intelligence quotient (IQ) determined at the sixth grade level. The relationship between ability and achievement measures was investigated, and other data germane to the study were analyzed.

Results

The findings can be summarized as follows:

1) The longitudinal variables of EA Slope and MA Slope correlate significantly with CGPA for both male and female students.

2) There is no relationship between the Y-intercepts of EA and MA with CGPA.

3) There is a high, inverse correlation between the EA and MA Y-intercepts and the EA and MA Slopes respectively.

4) For male and female students a statistically significant relationship exists between both EQ and IQ obtained in the sixth grade and CGPA.

5) The correlation coefficients of single test scores obtained in the sixth grade correlated with CGPA are as high as those coefficients found between the longitudinal measures of EA Slope or MA Slope and CGPA.

6) Multiple correlations using combinations of the above independent variables and CGPA do not markedly increase the relationships.

7) The amount of the difference between ability and achievement test scores is not related to college academic achievement.

8) There is considerable variation in the IQ scores obtained for a person throughout the elementary grades. Comparing the lowest and highest scores for each child between five and twelve years of age, the following differences were found: a minimum change of 7 IQ points, 64% of the group changing 16 IQ points or more, and 36% changing at least 21 IQ points.

9) The sixth grade IQ score of students whose IQ scores show great variation during elementary school correlated highly with CGPA. However, there is no significant correlation between sixth grade IQ and CGPA for those with stable IQ's, but these students appear to do more satisfactory work in college despite the level of their IQ.

10) A relationship exists between the IQ obtained as early as 96 months of age and CGPA.

11) Differences in the relationship of the independent variables to the dependent variable are found between male and female students.

12) Index numbers from the Knapp Studies have some usefulness in comparing the student bodies of divergent colleges.

Conclusions

Scores from the Stanford-Binet and the Stanford Achievement tests obtained prior to the seventh grade are significantly related to grade point average earned in college and

account for up to fifty percent of the variance. It is indicated that a number of other factors not studied here account for an equal amount of the variance and should be considered along with measures of ability and achievement in attempts to predict college achievement.

Microfilm $2.75; Xerox $5.60. 115 pages.

AN EVALUATION OF A PROGRAM FOR THE IMPROVEMENT OF HUMAN RELATIONS IN A HIGH SCHOOL BOYS' DORMITORY

(L. C. Card No. Mic 61-1470)

Wilfred Chris Langefeld, Ed.D.
The University of Nebraska Teachers College, 1961

Advisers: William E. Hall
Donald O. Clifton

Purpose of the Study

The purpose of this study was to evaluate a program of positive human relations which was activated in a high school boys' dormitory by a selected committee of high school boys in an attempt to develop an atmosphere of friendliness wherein individuals would be more accepting of one another and manifest an improved attitude toward one another.

Procedures

A developmental program of positive human relations was presented in weekly one hour conferences with the investigator to each of eight high school boys (the dean's committee) who placed this program into operation. During the interviews, continual emphasis was placed upon the value and dignity of one's fellow human beings. In this individual, developmental approach, an effort was made to stimulate a realization that human beings are the most important resource upon earth and that the efforts to develop their potentialities comprise one of the finest callings among mankind. Each week attention was given to additional aspects of the program and to the methods which might be used to implement the program in daily living.

The experimental group, in which the program of positive human relations was activated by the dean's committee, consisted of forty-nine high school dormitory boys on the campus of Concordia Teachers College, Seward, Nebraska. On two sister campuses of the experimental campus, the control group consisted of forty-two high school dormitory boys at St. John's College, Winfield, Kansas and eighty-seven high school dormitory boys at St. Paul's College, Concordia, Missouri.

A committee of eight boys was selected from each control dormitory, carefully matching the members of the dean's committee from the experimental dormitory.

The data gathering instrument consisted of three sections: a nominating questionnaire (NQ), a rating scale (RS), and a statement scale (SS). The NQ requested the selection of individuals who were outstanding examples of behavior normally considered good. The previously mentioned committees were selected on the basis of the NQ. The RS and SS focused attention on three aspects of human relations: friendliness, acceptance by others, and attitude toward others. By means of the RS, each dormitory boy was rated on a seven point scale in each of the three areas of human relations. The SS requested an appraisal of each dormitory boy according to a group of fifteen statements, ranging from very exceptional to very poor behavior, in each of the three areas.

The investigator administered the data gathering instrument three times on each campus: October, before beginning the program of positive human relations; February, midway in the program; and May, at the conclusion of the program.

The data were processed using analysis of covariance. Percentage studies were also prepared for comparison purposes.

Conclusions

1. The committee members (the dean's committee) who participated in the program of positive human relations became friendlier, were better accepted by the other individuals in the dormitory, and manifested a better attitude toward others in the dormitory.
2. The individuals living in the dormitory in which a program of positive human relations was operative through the activity of a committee practicing positive human relations became friendlier, were more accepting of others, and displayed a better attitude toward others.

Microfilm $5.45; Xerox $19.35. 426 pages.

AN ANALYSIS OF THE VOCATIONAL INTERESTS OF EDUCABLE MENTALLY RETARDED ADOLESCENT BOYS FROM THREE OCCUPATIONAL CLASSES

(L. C. Card No. Mic 60-6301)

James Frederick Magary, Ph.D.
Indiana University, 1960

This study was an exploratory investigation in the area of the vocational interests of educable mentally retarded white adolescent males enrolled in various special educational and vocational programs. The study provided information in reference to the following: (1) the vocational interest patterns as measured by the Geist Picture Interest Inventory of 90 retardates; (2) the stated hobbies and vocational preferences of these youth; (3) the influence of the occupational class of the fathers of these youth upon their vocational interest patterns and vocational preferences.

The following two null hypotheses were tested: (1) no differences will be found among the 12 GPII scale means for the three occupational classes and (2) there will be no differences among the GPII means of the entire retarded group and an undifferentiated normal group of male adolescents.

The literature was reviewed in the following areas: pictorial measurement considerations; the influence of family and occupational class on the vocational choices of normal and retarded youth; follow-up studies of the post school social and vocational adjustment of educable

retarded boys; vocational interests and vocational preferences of normal and retarded youth; age, vocational interests, and vocational preferences.

The GPII was individually administered to 45 retardates from Occupational Class I or whose fathers were employed at unskilled and semi-skilled work, 25 retardates from Class II whose fathers were employed at skilled, clerical and middle grade service jobs and 20 retardates from Class III whose fathers were employed at professional and managerial positions. A structured interview concerning the youths' vocational preferences and hobbies followed each boy's testing. The criteria for selecting subjects were: chronological age between 12-0 and 20-11; diagnosis of educable mentally retarded by a competent school psychologist within the last five years; white, with no observable evidence of physical handicap or psychosis; and enrolled in a special educational program for educable mentally retarded youth.

The GPII provided scores in the following interest areas: persuasive, clerical, mechanical, musical, scientific, outdoor, literary, computational, artistic, and social service, and dramatic. In addition, an educable mentally retarded employment feasibility scale was developed for the purposes of this investigation.

Various procedures were used in determining the influence of the Occupational Class upon the boy's vocational preference and his GPII interest pattern. These procedures included the computation of T scores for the entire sample of 90 retardates, item analyses, the "t" tests of significance of the difference between means and percentages.

The first null hypothesis was partially sustained as there were only four significant t's out of the total of 36. The second hypothesis was refuted as seven of the 11 scale means showed significant differences.

Among the findings and conclusions were the following:

(1) The GPII can be used for exploratory screening of interests of educable mentally retarded youth.

(2) The retarded subjects showed significantly higher clerical, mechanical, outdoor, and social service scores while the normal group showed significantly higher musical, scientific and computational scores.

(3) Class I boys showed a significantly higher mean scores in the outdoor area than Class II boys. Class II retardates displayed a significantly higher dramatic score than Class I and Class II retardates. Class II subjects showed a significantly higher mean interest score in music than did Class I boys.

(4) The stated vocational preferences of the retarded group as a whole showed a consistent trend toward most interest in semi-skilled and unskilled work, less interest in skilled and clerical jobs, and very little interest in professional and managerial positions. Furthermore, the preferences of the retardates were generally consistent in reference to the occupational class of their fathers.

The recommendations were as follows:

(1) Middle class and upper class parents of educable retarded boys should be informed of the limitations and possibilities of post school employment for their sons.

(2) Further investigations should be carried out in reference to the vocational interests and the vocational preferences of the retarded school population.

Microfilm $2.75; Xerox $7.80. 167 pages.

THE MEASUREMENT OF THE UNITY OF GROWTH AND THE TESTING OF THE STEADY RATE OF GROWTH HYPOTHESIS

(L. C. Card No. Mic 61-1767)

Jason Millman, Ph.D.
University of Michigan, 1961

The two areas of investigation in this study were the relationship existing among the various aspects of growth at a particular time and the rate at which these aspects change over time.

The concept of unity of growth is relevant to the first area of investigation and has been stated as the positive interrelationship of the various aspects of growth when measured at the same time. The second area of investigation is the steady rate of growth hypothesis which postulates that the organism releases energy for growth at a steady rate.

Unity of growth and steady rate of growth have been contrasted as follows: the former implies small variance of growth measures at any one given time while the latter predicts small variance of growth energy released at different times.

An analysis of variance design was used in this study to measure unity of growth. Fifty-three boys who attended the University School at Ann Arbor and who had complete data served as the "treatments" of the design; measures of height, weight, dental development, carpal development, grip strength, intelligence and reading ability were the "replicates." Because of the lack of comparability of age norms, growth measurements were converted to z-score units. A separate analysis was carried out for measurements taken at chronological ages 7, 8, 9, 10 and 11.

Results of these analyses were expressed as unbiased estimates of the components of variation due to differences between children and due to differences between the growth measures of each child. The result that the former was, on the average, one and two-thirds as large as the latter supported the unity of growth concept.

A formula which converted these variance estimates into the mean correlation between the growth measures at any one year was presented. For these data, this mean correlation was about .62 which implies existence of a high degree of unity of growth. These findings, even if tempered by the fact that known dependencies between such variables as height and weight helped account for the relatively low within-person variance or relatively high mean correlation between the measures, are probably inconsistent with the conclusions found by many investigators, namely that only a small degree of unity of growth was evidenced. Conversion of the raw scores to z-scores rather than age units was suggested to help account for the relatively high values reported in this study.

Theoretical assumptions involved in various direct tests of the steady rate of growth hypothesis were discussed. It was suggested that, under certain assumptions, an indirect test, which would avoid the problem of measuring total growth, was whether or not a representative sample of growth aspects each grew at a steady rate.

The procedure actually followed in this study was along this same line and involved computing, for each child, the correlation between the values of his growth aspects, expressed in z-scores, at chronological ages 7 and 11. (The

same sample of boys and growth aspects as used in the first part of the study was employed here.) The median of these correlations was .76. This finding suggested that the relation between the growth rates of the aspects was one of constancy and not compensation and offered some support to the steady rate of growth hypothesis.

Two general conclusions appear warranted by the results found in this study: 1) children who are advanced (or retarded) in one area of growth will have a tendency to be advanced (or retarded) in other areas of growth and 2) the relative superiority of one growth aspect to another, for a given child, will tend to persist during his childhood years. Microfilm $2.75; Xerox $6.40. 135 pages.

AN EVALUATION OF AN EXPERIMENTAL PROGRAM OF GROUP GUIDANCE IN THE JUNIOR HIGH SCHOOL

(L. C. Card No. Mic 61-1383)

Robert Arthur Montgomery, Ed.D.
The University of Texas, 1961

Supervisor: Dr. Royal B. Embree, Jr.

Problem:

Certain basic needs of boys and girls did not appear to be adequately met in the curriculum of the junior high school. An experimental course was devised which included units planned to meet certain of the unmet needs. The course was a year-long guidance class conducted at the eighth-grade level to replace the American History course usually taught at that time. A complete course of study was organized under four broad headings or units, each designed to cover six to nine weeks of school work.

The hypotheses were made that: (1) pupils enrolled in the course would feel that they had learned more about themselves and their abilities than would pupils enrolled in an American History course; (2) pupils enrolled in the experimental course would exhibit fewer personal problems at the end of the school year than they had exhibited at the beginning of the school year; and (3) parents and teachers of the pupils enrolled in the experimental course as well as the pupils themselves would feel that the experimental course was a worthwile and valuable experience.

Samples:

Two samples were drawn from two junior high schools in West Texas. The control group was composed of 208 boys and girls in the junior high school at Dumas, Texas, who were enrolled in a traditional American History class. The experimental group was composed of 208 boys and girls in the junior high school at Andrews, Texas, who were enrolled in the experimental guidance course. Except for the experimental course, the two groups were enrolled in identical subjects.

Methods:

1. An original 50-item checklist was administered to both groups at the beginning of the school year and at the end of the school year.
2. The Mooney Problems Check List was administered to 100 boys and girls of the experimental group at the beginning of the school year and at the end of the school year.
3. An evaluative questionnaire was administered to parents and teachers of pupils enrolled in the experimental course; the same questionnaire was also administered to pupils enrolled in the course.
4. Results of the checklists and questionnaires were tabulated, and comparisons were made between responses of the various groups.

Results:

1. The fifty-item check list gave indication that boys and girls enrolled in the experimental course felt that they knew more about themselves, their interests, abilities, and attitudes at the end of the year than at the beginning of the year.
2. The fifty-item checklist indicated that boys and girls enrolled in the experimental course felt that they knew more about themselves and their plans for the future than did the boys and girls enrolled in the traditional American History course.
3. Counselor and teacher observations indicated that boys and girls who had completed the experimental course felt freer to consult a counselor to discuss problems than they did prior to taking the course.
4. Parents, teachers, and pupils indicated that they believed American Life to be a truly worthwhile and valuable course, one which should be continued.
5. Results of the Mooney Problems Check List indicated that boys and girls who completed the experimental course had fewer listed problems than they did at the beginning of the course.
6. The success with which the experimental course has met in one school system tends to suggest that a course of this type might accomplish equally effective results in other school systems.

Microfilm $2.75; Xerox $5.60. 111 pages.

EARLY IDENTIFICATION OF POTENTIALLY SUCCESSFUL GRADUATE STUDENTS

(L. C. Card No. Mic 61-1661)

Theodore Frederick Renick, Ed.D.
University of Illinois, 1961

Purpose

This study was designed to find criteria, other than grades and group intelligence test scores, which would aid in the identification of high school students potentially capable of success at the graduate school level. Prior research in this area suggested that the high school grades and group intelligence test scores of a large proportion of people who earn Ph.D's were slightly above average.

Procedures

All the individuals who earned Ph.D.'s and Ed.D.'s at the University of Illinois in the 1958-1959 academic year and who had attended U. S. high schools were asked to complete and return questionnaires. The questionnaires sent to subjects included objective and open-ended questions designed to provide information about their family backgrounds, high school experiences and self-perceptions as they remembered themselves in high school and in the present. Subjects were asked to describe in detail the factors which influenced them to attend undergraduate school and to pursue a doctoral degree.

Questionnaires were sent to the high schools from which all the subjects who responded had graduated. The information requested of the high schools included rank in class, intelligence test scores, personality ratings and teachers' anecdotal descriptions of the subjects' academic ability and salient behavioral characteristics.

Subjects' descriptions of themselves in the present were compared with their descriptions of themselves in high school to test hypotheses about the changes which occurred in their self-perceptions. High school intelligence test scores were correlated with the scale scores of the "Self-Description Inventory." Frequency distributions of responses to family background and high school experiences were analyzed.

Findings

The following hypotheses were accepted.

1. The populations from which the present sample and the sample of a related study were drawn are the same in terms of the proportion of people with high school I.Q.'s of 120 or less.

2. The proportion of people who change majors from the natural sciences to the social sciences between earning the baccalaureate degree and the doctoral degree is greater than .5.

3. People who earn doctorates experienced significant gains in self-assurance as measured by the "Self-Description Inventory" between the time they were in high school and completion of the doctorate.

Intelligence quotients taken directly from high school records were found to correlate near zero with the objective measures of initiative and self-assurance. Initiative Scale scores and Self-Assurance Scale scores were taken from responses to the "Self-Description Inventory." Subjects completed the inventory two times, once as they were in the present and once as they thought they would have responded when they were in high school.

Examination of subjects' open-ended responses, high school and family background questions and the teachers' comments suggested the following descriptive statements about those who earn doctorates.

1. As high school students they were serious, well-liked, well-adjusted individuals.

2. They were most frequently encouraged to attend college by close relatives. The mothers influenced this decision more than the fathers.

3. They pursued doctoral degrees because they were encouraged by professors and because the degree permitted them to engage in work which they found stimulating, rewarding and self-directed.

Microfilm $2.75; Xerox $4.60. 88 pages.

INTELLECTUAL AND PERSONALITY CHANGES IN COLLEGE STUDENTS AS MEASURED BY THE COOPERATIVE COLLEGE ABILITY TEST AND THE PERSONAL JUDGMENT SCALE

(L. C. Card No. Mic 61-1378)

Vincent Casimir Waiches, Ph.D.
The University of Texas, 1961

Supervisor: Dr. Royal Embree

The primary purpose of this research was to investigate what changes took place in the academic ability and self-structure of students from the beginning of their freshman year to the end of their fourth year in college. The subjects were 50 male and 50 female volunteers from the Colleges of Arts and Science, Education, Fine Arts, and Business Administration who had entered The University of Texas in the Fall of 1955. They were retested in the Spring of 1959 on the Cooperative School and College Ability Test (SCAT) Form 1A, and on the Personal Judgment Scale (PJS). The SCAT yields Verbal, Quantitative, and Total Scores. Dawkins had developed a self-rating personality scale called the PJS which was administered to all the freshmen who entered the University in the Fall of 1955. This inventory contains 50 trait words describing oneself on a five-point scale in the three categories of Self-concept, Self-acceptance, and Super-ego. The Discrepancy Score which is obtained by subtracting the Self-concept total from the Super-ego score is assumed to be an index of personal adjustment.

A study of the data relating to intellectual growth indicates that the sample of 100 subjects taken as a composite group made statistically very significant increases on all their SCAT scores. With regard to the differences related to sex, it was found that both men and women very significantly increased their Verbal, Quantitative, and Total SCAT Means on the 1959 retest. In each case the men gained more than the women, but these differences were not significant. Verbal scores increased more sharply than Quantitative scores. The women seemed to have had a lower ceiling of academic ability than the men. The coefficients of stability on the SCAT after a four-year period were relatively high: for the men, Verbal .83, Quantitative .75, Total .78; for the women, Verbal .81, Quantitative .82, Total .90. All the subjects must have increased at a somewhat uniform rate in their intellectual growth. Many variables must have influenced the very significant increases in every area of the SCAT, but basically only a growth in intellectual ability seems to explain fully the gains made. The 1955 SCAT produced higher correlations with a four-year Grade Point Average than the 1959 retest. These 1955 SCAT and GPA correlations were: for the men, Verbal .34, Quantitative .35, Total .42; for the women, Verbal .53, Quantitative .30, Total .51.

On the PJS, neither the men nor the women made any

statistically significant changes from 1955 to 1959 with respect to Self-concept or Self-acceptance scores. The men increased their SC scores a little, but decreased twice as much on SA. The women had gains in both areas. Each sex reduced its Super-ego Mean on the retest by a margin that was significant at the .05 level. The decrease in Discrepancy Scores was significant at the .01 level for both sexes. On the basis of this finding, one could conclude that the subjects indicated better adjustment as seniors than as freshmen. Not too much practical validity can be attached to such a decrease, however, because the change in D-scores seems to depend more on a weakening of the Super-ego than on a positive growth of the Self Concept. Higher correlations were found between D-scores and SE than between D-scores and SC. The former yielded positive coefficients, while the latter produced negative ones. There were no significant differences between the changes of the two sexes.

The hypotheses that students with better adjustment as reflected by lower D-scores on the 1955 and 1959 PJS would not achieve a higher Grade-Point Average could not be rejected. None of the four coefficients of correlation significantly exceeded zero.

Finally, the differences between near-graduating students and drop-outs on the 1955 SCAT and PJS were investigated. The evidence of the data firmly supported the proposition that the students who persevered in college tended to be those who initially had more scholastic ability. In all cases of comparison of the group Means, those who persevered outscored those who dropped out by a difference that was significant at the .05 or .01 levels of confidence. It was found that the PJS variables did not discriminate between those students who persevered and those who dropped out.

Microfilm $2.75; Xerox $4.80. 92 pages.

FACTORS ASSOCIATED WITH UNDERACHIEVEMENT IN THE COLLEGE OF ARTS AND SCIENCES AND THE COLLEGE OF AGRICULTURE AT CORNELL UNIVERSITY

(L. C. Card No. Mic 61-1430)

Mary Stillman Zink, Ph.D.
Cornell University, 1960

Purpose

The purpose of this investigation was to determine whether there were patterns of socio-economic variables and personality attributes that were characteristic of the underachiever in two of the colleges of Cornell University and, if so, whether they were identifiable from information given on admissions records. A secondary purpose was to determine whether the findings about the underachiever were similar to the findings of the Cornell Attrition Study concerning the relationship of certain non-intellectual variables and student drop-out. The ultimate goal was to synthesize the information obtained so that it might be used by admissions officers and high-school counselors for the more effective guidance of the prospective college student.

Procedures

The sample consisted of 897 students in the College of Arts and Sciences and 365 in the College of Agriculture who entered the University in the fall of 1953 and 1955.

Criteria for achievement and underachievement were based on the second-semester cumulative average predicted for each entering freshman. The underachiever was defined as that student who attained a first-year cumulative average which was five or more grade points below his predicted average.

Information on the Application for Admission and the Secondary School Report for each student in the sample was coded and placed on IBM cards. Variables studied were in the broad areas of home, community, and school background, extracurricular interests and vocational goals, assessments of personality attributes by high school personnel, and high school and college academic history. Differences between achievers and underachievers were evaluated for significance by the chi square method. Comparison was made between achievers and underachievers by sex and by College.

Findings

The student body of the College of Arts and Sciences differed from the student body of the College of Agriculture. Students in Agriculture -- regardless of academic achievement -- came from small communities and both small and large public schools. Achievers in Arts and Sciences tended to come from large communities and large public high schools. Underachieving men in Arts and Sciences tended to come from small private schools and from communities under 50,000 population; these findings were significant at the .01 level. Underachieving men in Agriculture tended to come from communities under 25,000 in population; this was significant at the .05 level.

Recommendations made by secondary-school officials for male underachievers in the College of Arts and Sciences contained more statements expressing reservations concerning the emotional stability, wisdom of choice of course, and ability to do the work entailed, than was true for the achievers. In the College of Agriculture, secondary-school officials questioned wisdom of course selection more often for underachievers than achievers. All these findings were significant at the .01 level.

There were no significant differences between underachieving and achieving women in either college.

Achievers and underachievers could not be distinguished on the basis of parental occupational or educational background, on the basis of education of older siblings, or by geographical area of home community.

Underachievers in both colleges tended to drop out earlier and in greater numbers than achievers. Fifty percent of the underachievers in the College of Agriculture dropped from college at the end of the first year.

Recommendations

Changes in the Application for Admission were suggested so that information would be more comparable in the areas of vocational goals, extracurricular activities, absence from school and financial need.

Investigation of possible ways to quantify size of high-school graduating class so that it could be included as a variable in the regression equation was recommended.

Further investigation of the personality attributes now assessed by secondary school authorities should be pursued. Microfilm $3.15; Xerox $11.05. 241 pages.

EDUCATION, RELIGION

AN HISTORICAL ANALYSIS AND EVALUATION OF JEWISH RELIGIOUS TEXTBOOKS PUBLISHED IN THE UNITED STATES, 1817-1903.

(L. C. Card No. Mic 60-6159)

Max Andrew Shapiro, Ed.D.
University of Cincinnati Teachers College, 1960

The purpose of this study was: (1) to analyze the influence of the American environment on the first Jewish Religious School textbooks, (2) to discover the subject matter taught in the Jewish Religious School during the nineteenth century, (3) to evaluate the religious content and approach of the Jewish texts, and (4) to analyze the influences of the developing educational psychology and methodology of the nineteenth century on the texts used by the Jewish Religious School during this period.

The terminal years were placed at 1817 and 1903. In 1817, the first Jewish Religious School textbook was published in the United States. In 1903, the Department of Synagogue and the School Extension was established by the Union of American Hebrew Congregations. With the growth of this Department came a new era on the history of Jewish textbooks.

The first Jewish textbook in English published in the United States appeared in 1817. It was called Elements of the Jewish Faith and was written by Samuel I. Cohen. It was a catechism whose approach was in keeping with Orthodox Judaism. In 1820, an anthology, Selections of a Father, was compiled by Isaac Gomez, Jr. for his son. Not only did this test certain religious instruction but also general information.

In 1838, the first Jewish Religious School in the United States was established in Philadelphia. As more such schools were founded, there arose an increasing demand for texts. The first texts produced were primarily all-purpose catechisms. By the last quarter of the century, however, texts on the specific subjects taught in these schools were being written.

The first Hebrew text, The Hebrew Reader, by Isaac Leeser was published in 1838. In 1849, A Class Book for Jewish Youth of Both Sexes dealing with general information about Judaism was written by Henry A. Harris. Ten years later, H. A. Henry wrote A Synopsis of Jewish History, the first Jewish history text that extended beyond the Biblical period. The first Bible textbook, other than a catechism, was written in 1877 by De Sola Mendes under the title The Child's First Bible. In 1871, the first Confirmation Manual made its appearance. The study of ethics was not placed in a book to itself until 1884, when Krauskopf and Berkowitz wrote Biblical Ethics.

The religious content and philosophy of the early textbooks were primarily orthodox. The Essence of Judaism (1861), by Isaac M. Wise, the progenitor of Reform Judaism in America, made the first break with tradition.

The concepts of the great educational philosophers of the eighteenth and nineteenth century are not reflected in most of the Jewish texts written in the period under consideration. The catechism was the principal form of text, and memorization was the educational method advocated. In 1886, A Guide for Sabbath School Teachers issued by the Union of American Hebrew Congregations undertook to instill the new approach to teaching. In this volume, teachers are instructed to discuss rather than lecture, to encourage rather than to scold, to motivate the child, and to bring him an understanding of the subject matter under consideration. The catechism as a text and memorization as a method were attacked.

The ideas with which the Jewish Religious School texts deal are usually adult ideas. Most often the early textbooks presented these ideas in a vocabulary that was often difficult and in a format that was invariably unattractive. Illustrations almost never appear. The type is small with little white space between paragraphs. The vocabulary is often abstruse and abstract.

Microfilm $3.40; Xerox $11.95. 262 pages.

EDUCATION, TEACHER TRAINING

AN EVALUATION OF THE PROFESSIONAL EDUCATION PROGRAM IN TWO LUTHERAN TEACHERS COLLEGES

(L. C. Card No. Mic 61-1469)

Walter Frederick Hardt, Ed.D.
The University of Nebraska Teachers College, 1961

Adviser: Dr. Gayle B. Childs

Statement of the Problem

Teachers are important to the future of our country; therefore it is important that teachers be very well prepared. A recognition of this fact has led to a high degree of interest on the part of both educators and the lay public in the whole area of teacher preparation. In view of this interest, it was felt that an investigation of the reactions of recent graduates to the program of professional education in selected institutions would be very worthwhile. Teacher opinion constitutes only one means, but still a very important means, of evaluating a program of professional education.

While this investigation involves two private, parochial schools of teacher training, their program of professional education generally parallels that of most other schools, private or public.

The purposes of the investigation were to determine, according to opinions of teachers who were recently graduated from the colleges, 1) whether the professional education program provides adequate preparation in that area; 2) which courses are most and which courses are least effective in preparing students to be teachers; 3) which courses might be added to or dropped from the professional program; 4) whether any outside experiences aid in the training of teachers; and 5) what changes, if any, would result in the greatest improvement in the program of teacher education.

Procedure

The specific purposes of the professional courses of the two schools were determined by securing statements of purpose from the faculties. Also, literature relating to professional education was reveiwed. From these purposes and readings a questionnaire checklist of 50 items was set up to determine what understandings students had gained from the professional courses. A second part of the questionnaire listed 8 open end questions which asked for answers to questions concerning the professional program. This questionnaire was sent to over 500 teachers who had graduated from the two schools through the years 1955 to 1958 inclusive.

A second questionnaire was devised by restructuring the 50 item checklist into 10 open end questions. This questionnaire was sent to administrators of schools to which graduates of the years 1955 to 1958 were assigned as teachers.

In order to obtain more detailed information, personal interviews were conducted with 48 of the teachers who completed the questionnaire. These interviews were based on an extension of the 8 open end questions which formed one part of the teacher questionnaire.

Findings

The findings of this study may be summarized as follows:

1. Graduates of the two schools felt adequately prepared in 68 percent of a selected list of 50 objectives of all professional education courses.
2. Graduates were considerably more positive in suggesting additions to the professional education program than they were in suggesting deletions.
3. Student teaching was considered to be the greatest strength of the professional education program and an emphasis on theory was regarded as the greatest weakness.
4. College experiences outside the regular academic program were thought to contribute materially to the total teacher education program.
5. The one change suggested which would improve the teacher education program the most was an improved, practical, and realistic student teaching experience.
6. Generally, reactions of graduates from the two schools were similar although some differences existed in regard to specific courses.
7. More recent graduates rated the professional education program higher than did graduates of earlier years. Microfilm $2.75; Xerox $9.45. 207 pages.

A STUDY OF THE PERCEPTIONS THAT ADMINISTRATORS, ELEMENTARY TEACHERS, CONSULTANTS, AND SPECIAL AREA TEACHERS HAVE OF THE ELEMENTARY SPECIAL AREA TEACHER AND CONSULTANT ROLE.

(L. C. Card No. Mic 61-1950)

James David Hoffman, Ed.D.
Michigan State University, 1959

Major Professor: William Vernon Hicks

Statement of the Problem

The purpose of this study was to identify the role expectations that elementary teachers, elementary administrators, elementary consultants and special area teachers had of the special area teacher-consultant roles, and make a clear delineation between the two roles. Role expectations of the respondent groups were compared and convergence and divergence of opinion noted.

Procedure

Elementary administrators, teachers, consultants and special area teachers in seventeen communities in Michigan were given a questionnaire dealing with seven selected consultant-special area teacher roles. These respondent groups were asked to indicate the degree of expectation they held concerning their perception of how the special area teacher-consultant performed the roles.

Findings

It was hypothesized and proven that there was inconsistency in role perception of these roles with more divergence of expectation than convergence.

It was found by use of the "F" test that significant differences existed in the role perception of the special area teacher by these four respondent groups on thirty-two of the sixty-two items on a questionnaire. It was found by the use of the "F" test that significant differences existed in the role perception of the consultant by these four respondent groups on thirty-two of the sixty-two items on a questionnaire.

There was divergence of expectation concerning where the role of the special area teacher occurred on six of eleven items, divergence concerning teaching roles with children on five of eleven items, divergence concerning consulting-teaching relationships with teachers on five of fifteen items, divergence concerning educational background and role effect on five of six items, divergence concerning status effects on four of six items, divergence concerning responsibilities of supervision on five of nine items, and divergence concerning the role as a representative of the central office on two of four items.

There was divergence of expectation concerning where the role of the consultant occurred on six of eleven items, divergence concerning teaching roles with children on five of eleven items, divergence concerning consulting-teaching relationships with teachers on ten of fifteen items, divergence concerning responsibilities of supervision on four of nine items, and divergence concerning the role as representative of the central office on one of four items.

Individual groups' perceptions caused more significance

of divergence of role perception than variables within the single groups.

There was perceived a similarity between the actions of the special area teachers and consultants on forty-four of the sixty-two items, and a difference between the actions of the special area teachers and consultants on eighteen of the sixty-two items. For this data analysis the respondent groups were considered as one group of educators. It was hypothesized there was intermixing of roles and this was partially proven.

Viewing the respondent groups separately reveals that teachers view the roles as similar in action and performance on fifty-two of the sixty-two questionnaire items, administrators on thirty-eight of the sixty-two items, consultants on forty of sixty-two items, while special area teachers view the two roles as similar on only thirty of the sixty-two items.

This indicates that teachers, who have daily contact with both roles, see little difference between the roles, while special area teachers consider the difference great. Consultants and administrators perceive great difference also. Possibilities of role conflict are definitely established.

Recommendations

To lessen possibilities of role conflict concerning these positions, it is advised that school groups begin with the convergent areas of role perception and work toward eradicating their differences of thought concerning the divergent areas. School groups should attempt to become more consistent in their expectations of the particularized roles, and delineate more clearly between the two roles.

These findings could be the basis for bringing about convergent expectations if studied in in-service training programs, pre-service training programs, and consultant-special area teacher meetings. This is necessary to establish "common-ground" expectations, when viewing the trend toward the evaluation of specialization and subject learning in America's public schools of today. Our educational institution is becoming more complex, and every role acted in it must be perceived clearly and consistently by all groups, so that we may have smoothly operating social relationships. Smooth relationships are powerful determinents of the successful functioning of an institution.

Microfilm $2.75; Xerox $7.60. 164 pages.

DETERMINING THE TRAINING NEEDS FOR SELECTED AGRICULTURAL OCCUPATIONS IN MASSACHUSETTS AND THE ROLE OF VOCATIONAL AGRICULTURE IN MEETING THESE NEEDS

(L. C. Card No. Mic 61-1436)

Robert Carroll Jones, Ed.D.
Cornell University, 1960

Purposes. The specific purposes were (1) to determine the duties, and the essential skills, knowledges and attitudes needed by individuals planning to enter the following non-farm agricultural occupations: (a) selective breeding association technician, (b) feed company fieldman, (c) farm machinery mechanic, (d) landscaping, (e) dairy products processor, and (f) farm machinery salesman; and (2) to determine to what extent the Massachusetts program of vocational education in agriculture was meeting the training in essential skills, knowledges and attitudes of individuals planning to enter any of these six non-farm agricultural occupations.

Method. A job analysis approach was used in conducting the study. The data were secured by the interview method from a minimum of six employers and employees. Using an interview schedule with the assumed duties, skills, knowledges and attitudes for each occupation, the respondents were asked to rate each item based upon their estimate of the work they were doing. The ratings were: much, recorded as three; some, recorded as two; little, recorded as one; or none, recorded as zero.

From the quantified symbols rank scores were calculated for each duty, skill, knowledge and attitude for all the occupations. These scores were used as a basis for rating the items as much importance, some importance, little importance, or no importance.

For carrying out purpose number two, the essential skills, knowledges, and attitudes were summarized in a questionnaire. This was sent to all the agricultural schools and departments in Massachusetts requesting the agricultural instructors to indicate the extent to which the vocational agriculture program was providing training in each of the skills, knowledges, and attitudes as listed. Rank order scores of the degree to which vocational agriculture provided training in each of the items were calculated with the results presented in tabular form.

Findings. A comprehensive list of duties, skills, knowledges, and attitudes considered essential for each occupation were rated much importance, some importance, or little importance. From thirteen to twenty-two duties were listed for the six non-farm agricultural occupations. Fewer duties were rated of much importance for farm machinery mechanics, landscapers and dairy products processors than for the other occupations.

The skills identified encompassed a wide range of agricultural and human relations activities. From thirty-nine to ninety-one skills were considered essential for the occupations. Over one-half of the skills were rated of much importance for technicians and fieldmen.

A very high proportion of the essential knowledges and attitudes for these occupations were rated of much importance.

The Massachusetts program of vocational education in agriculture was only partially meeting the training needs of individuals planning to enter any of the six non-farm agricultural occupations. The program did meet to a high degree the training needs in attitudes for each of the occupations. The training needs for dairy products processors were being met to an extremely limited degree by vocational agriculture.

Conclusions. It was concluded that knowledges in the area of operating and managing the farm business and/or productive farming contributed to proficient performance in each of the six non-farm agricultural occupations and vocational agriculture makes a major contribution in training individuals for these occupations by providing experiences in productive farming.

Microfilm $5.05; Xerox $17.80. 394 pages.

A STUDY OF GRADUATES OF THE UNIVERSITY OF GEORGIA WHO ARE CERTIFIED TO TEACH WITH RESPECT TO ENTRANCE INTO THE TEACHING PROFESSION

(L. C. Card No. Mic 60-4652)

Mary Oellerich Murphy, Ed.D.
University of Georgia, 1960

Major Professor: Albert J. Kingston

THE PROBLEM

The problem of the present study is to compare a group of graduates trained as teachers who subsequently entered the teaching profession, with a group of graduates who trained as teachers but who did not enter the teaching profession.

SOURCE OF DATA AND PROCEDURES USED

The June graduates of the University for 1957 and 1958 were selected as the population on the basis of test results availability, recency of attendance, and adequacy of information available. A total of 496 graduates qualified as trained teachers at the baccalaureate level. Of 496 graduates, 138 did not enter the teaching profession; 324 did enter the teaching profession. These two groups comprised the base population for this study. The desired information could not be obtained for 34 graduates.

The principal sources of data used were the "application for admission" form and the "permanent record card" made available in the office of the registrar of the University and the freshman placement examination results made available in the Guidance Center of the University.

From these sources forty-six items were selected on the basis of availability for approximately the entire population as well as the inherent importance of the item of information itself. These items of information were grouped into four major classifications:

1. The personal background of the graduate.
2. The secondary school background of the graduate.
3. The scores earned by the graduate on the freshman placement examinations administered by the University of Georgia.
4. The college performance of the graduate.

Each of these four major groupings was further divided into "continuous" and "non-continuous" variables. Those factors considered to be "continuous" were subjected to both the chi-square test of significance and the "t"-test of significance. The chi-square test was used to test the hypothesis that the differences in the distributions of entries and non-entries were due to chance alone, while the "t"-test was used to test the hypothesis that the difference in mean scores of the entries and non-entries was due to chance alone. When the operation of chance factors alone could be considered to account for the observed difference in distributions or difference in mean scores fewer than five times in one hundred (the 5 per cent level of confidence), the observation was considered to be the result of other than chance operation; that is, the two groups being compared were considered to be "significantly" different.

SUMMARY OF FINDINGS OF THE PRESENT STUDY

The following are believed to be the most important findings when the entries and non-entries were compared on the basis of forty-six factors:

1. The entries into the teaching profession were significantly younger than the non-entries. ("p_t" =< .05)
2. More women certified to teach entered the teaching profession than would be expected from chance alone, the percentage being 72.8 for the women entries versus 27.2 for the men entries. ("$p_x 2$" = < .001)
3. The number of years between high school graduation and baccalaureate graduation was significantly less for the entries than for the non-entries. ("p_t" = > .01; "$p_x 2$" = < .05)
4. Larger percentages of entries than of non-entries were in the teaching fields of business education, elementary education, and physical education. Smaller percentages of entries than of non-entries were in the teaching fields of agricultural education, English, and social studies. An equal percentage of entries and non-entries was in the teaching field of home economics. ("$p_x 2$" = < .001)
5. A significantly larger percentage of entries than non-entries registered for the degree program of B.S. in Education. This was the only degree program in which the percentage of entries exceeded the percentage of non-entries. ("$p_x 2$" = < .001)
6. A significantly larger percentage of entries than non-entries graduated from the degree program of B.S. in Education. This was the only degree program from which graduated in which the percentage of entries exceeded the percentage of non-entries. ("$p_x 2$" = < .001)
7. Secondary school background factors and freshman placement examination factors did not differentiate between graduates trained as teachers who entered the teaching profession and graduates trained as teachers who did not enter the teaching profession.

Microfilm $2.80; Xerox $9.70. 214 pages.

A STUDY OF THE FLORIDA SCHOLARSHIP PROGRAM FOR THE PREPARATION OF TEACHERS

(L. C. Card No. Mic 61-1294)

Robert Wilson Sims, Ed.D.
The Florida State University, 1961

Statement of the Problem

The problem was to determine the effectiveness of the Florida scholarship program for the preparation of teachers as indicated by:

1. A comparison of a sample of teachers prepared under the scholarship program with a sample of other teachers prepared in the same institutions during the same period.
2. The degree of association between scholarship examination scores and the incidence among scholarship holders of completion of a four-year professional program, entrance into, and survival in the teaching profession in Florida.

3. The degree to which the program through scholarship aid has contributed to the teaching force of the State by encouraging able persons who would not have otherwise done so to prepare for, to enter, and to remain in the teaching profession in public schools in Florida for at least one year beyond the time necessary to repay the amount of the scholarship loan through teaching service.

Procedure

Educational literature pertinent to the investigation was reviewed to provide a background of previous research in areas related to the problem. Florida laws, State Board of Education regulations, and files of the Florida State Department of Education were examined for information concerning the Florida scholarship program for the preparation of teachers. A questionnaire was utilized to secure information from selected Florida teachers who had held teaching scholarships. The problem was approached through the formulation and testing of null hypotheses. Appropriate data were presented and analyzed.

Major Findings and Conclusions

1. It appears that high school students who receive awards under the Florida scholarship program are selected from among the most capable and highest achieving Florida high school graduates.

2. Florida teachers prepared under the Florida scholarship program for the preparation of teachers compare favorably with other Florida teachers prepared at the same time and in the same institutions as those attended by scholarship holders.

3. It appears that Florida teachers prepared under the Florida scholarship program for the preparation of teachers, as a group, earn higher grade point averages while in college than do other Florida teachers prepared at the same time and in the same institutions as those attended by scholarship holders.

4. It appears that a higher percentage of Florida teachers prepared under the Florida scholarship program for the preparation of teachers obtain certification in the field of mathematics than do other Florida teachers prepared at the same time and in the same institutions as those attended by scholarship holders.

5. Significant differences were not observed between weighted percentile scores of scholarship holders who prepared for, entered, or remained in the teaching profession and those who did not. However, significant differences were observed between scores made on certain sub-tests as follows:

a) Individuals who were graduated from college as scholarship holders, as a group, made higher scores on the Cooperative Reading Comprehension Test than did those whose scholarships were terminated prior to graduation.

b) Individuals who were graduated from college as scholarship holders and began teaching in Florida public schools made lower scores on the Cooperative Natural Science Achievement Test than did those who were graduated from college as scholarship holders but did not teach in Florida.

6. The scholarship was reported as either a determining factor or a major factor in at least one important decision leading to a career in teaching by 19 (73 percent) of the 26 individuals included in this study who continued to teach in Florida public schools for at least one year after having met legal requirements for canceling all scholarship notes through teaching service.

Microfilm $2.75; Xerox $6.60. 140 pages.

A PRINCIPLE AND CONCEPT PERSPECTIVE OF CONSERVATION

(L. C. Card No. Mic 61-1817)

Paul Abt Yambert, Ph.D.
University of Michigan, 1961

In recognition of the usefulness of accurate generalizations as teaching and learning devices and in the fields of applied resource management, this study was undertaken to develop a cadre of descriptive and predictive generalizations pertaining to the field of conservation.

The procedure utilized included a survey and analysis of some representative recent studies of generalizations related to conservation education at the elementary and secondary school levels and a broad range of professional literature in conservation and allied fields.

Based upon these analyses, some generalizations were selected as being inclusive and/or representative of their group; others were formulated by the writer to complement these.

The explication of the twelve basic generalizations thus derived included pertinent quotations supporting them and rather extensive explanatory notes.

The generalizations, some of which involve precise definitions, presented in the study are summarized below:

1. Potential and pristine resources and resistances may be converted into resources and resistances in-being by the action of culture upon the environment.
2. Due to societal and technological factors, resources and resistances in-being may cease to function and revert from culture to the environment.
3. Cultural advance tends to be restricted when there is excess disparity in the degree of advance among the component parts of the culture.
4. The magnitude and diversity of both resources and resistances which may pass through the conversion zone and retroconversion zone tend to increase as culture advances.
5. As the total quantity of a stock resource which has been consumed or naturally deteriorated increases, the absolute grade of the associated potential resource tends to decrease.
6. The amount of energy necessary to convert potential stock resources into stock resources in-being increases as the absolute grade of the potential stock resource decreases.
7. Reduction in the flow of some resources and resistances tends to become irreversible due to societal, technological, and/or biological factors.
8. Yield of flow resources and resistances may be

maintained indefinitely if flow rates, or population levels, do not reach the critical zones.

9. Net resources may be increased by the complementary use of resources and/or the anticomplementary use of resistances.
10. Net resources may be increased by societal and technological augmentation of resources and/or diminution of resistances.
11. With respect to the time remaining until resources or resistances cease to function, the significance of the residual quantity of the potential resource or resistance varies in inverse proportion to the consumption rate.
12. The amount of time over which resources and resistances can continue to function may be optimized by distribution according to priority scales based upon their inherent properties.

Conclusion

It is a thesis of this study that the generalizations presented can serve as a basic framework adaptable to many situations—both in the educational and applied resource management fields. Within this framework may be appended additional generalizations, and from this framework may be derived more numerous generalizations at different levels of abstraction.

Microfilm $2.75; Xerox $9.00. 196 pages.

EDUCATION, THEORY AND PRACTICE

ACADEMIC MATHEMATICS IN NEW YORK CITY PUBLIC SCHOOLS SINCE 1930

(L. C. Card No. Mic 61-1404)

Ruth Grabenheimer, Ph.D.
Columbia University, 1961

In the educational system of New York City there are interactions among the State Education Department, the Board of Education of New York City, school administrators, teachers, parents, and students. Such interactions bring about modifications and changes in educational policies and procedures. This study presents an analysis of these interactions with respect to one aspect of the curriculum, mathematics.

Although much of the subject matter taught in 1930 is still taught in 1960, significant changes have been made in New York City's mathematics curriculum. The early changes were made because mathematics educators realized that many students had neither the ability nor the desire to study the traditional mathematics courses. However, all should benefit from the study of at least one year of high school mathematics. For these students, general mathematics was added to the curriculum. It includes basic concepts from all the traditional high school mathematics courses.

Recent changes in the curriculum were made because the needs of the superior students had been neglected and because the advances in research and in industry demanded that more advanced as well as modern mathematics be taught to the best students. College courses in analytic geometry and calculus are now taught in many high schools. In addition such courses as programming for computers and mathematical techniques of science are taught to the best students. They are also stimulated by mathematics club speakers, by math team problems, by research they perform for articles for mathematics publications, and by such television programs as "The Mathematics Club of the Air." This concerted effort to interest the superior students has resulted in a significant increase in the per cent of seniors who study mathematics.

For most of the courses, New York City uses the state syllabi. The State Education Department tests the effectiveness of its program by means of Regents examinations given simultaneously throughout the state. It believes this is the most effective method for testing what was learned. These tests may also show what was not taught. The Regents tests include questions which test understanding as well as mastery. This has been the basis of New York City's mathematics program in elementary school and junior high school for the past decade. High school teachers are also stressing understanding as well as mastery much more than they did in the past.

Since there are three tracks of courses in high school mathematics, it is essential that adequate guidance be given to all students. They are programmed for courses for the slow, average, or superior students according to their general record, mathematics record, and scores on standardized mathematics tests as well as their interests.

Much effort has been exerted in recent syllabi in integrating the various branches of mathematics. Integration clearly shows students the need for learning different branches of mathematics and eliminates the need for repeated review. Correlation of mathematics with other subjects has also been attempted. This has been successful in specific topics but not for entire courses.

High school educators have tried to make the learning of mathematics continuous from the beginning of elementary school through college by studying what their students learned before and what those who will continue its study will learn later. New York City high school students who study mathematics can receive an excellent program because it has been prepared by experts on the state and local levels and is taught by highly qualified teachers. Today more and more students avail themselves of these resources.

Microfilm $4.15; Xerox $14.65. 323 pages.

AN EXPERIMENTAL STUDY OF THE EFFECT ON VARIOUS READING ACHIEVEMENT SCORES OF TEACHING SELECTED CONTEXT AIDS TO A GROUP OF FIFTH GRADE PUPILS

(L. C. Card No. Mic 60-6806)

Lawrence Erhardt Hafner, Ed.D.
University of Missouri, 1960

Supervisor: A. Sterl Artley

PURPOSE: To evaluate the effects on reading achievement scores of an experimental group of fifth grade pupils of teaching the nature and use of selected context aids. The achievement tests used were designed to measure reading comprehension, vocabulary-in-context, and context comprehension, and to yield a vocabulary-comprehension composite called average reading.

METHOD OF RESEARCH:

(1) The reading achievement of the experimental group was compared to the reading achievement of two control groups. The experimental group and the control-I group were two fifth grade classes in the same school. The control-II group came from a school located in a more favorable environmental setting.

(2) Characteristics of the groups in terms of intelligence and reading achievement were obtained at the beginning of the experiment. The California Test of Mental Maturity, the SRA Reading Test, and the Comprehension "X" Test (constructed by the writer) were used as pre-test instruments. Because of inequalities existing among the groups in intellectual and reading achievement status, the analysis of covariance statistical technique was utilized. A chi-square technique and the "t" test of the significance of the difference between means were also utilized.

(3) The experimental variable was instruction in the use of these selected context aids: contrast, explanatory words and phrases, and two inferential aids. Instruction was given for three thirty-five minute periods per week for a total of four weeks.

(4) At the end of four weeks the pupils of all the groups were administered an alternate form of the reading achievement tests.

SUMMARY:

(1) The major null hypotheses which posited no statistically significant differences to exist among the groups in final reading achievement as revealed by tests designed to measure comprehension, vocabulary-in-context, average reading, and context comprehension, were retained.

(2) The experimental group showed greater, though not statistically significantly greater, gains in vocabulary-in-context and average reading than either control group, notwithstanding the initial advantages enjoyed by the control-II group.

(3) Although the experimental group exhibited a higher percentage of children showing gain in SRA vocabulary than the control-II group, and although it closely approached significance at the .05 level, it did not meet the criterion of statistical significance at the .05 level.

(4) The experimental group exhibited a statistically significantly higher percentage of pupils showing gain in SRA comprehension than the control-I group. This finding was statistically significant at the .05 level.

CONCLUSIONS:

(1) After short term instruction in the use of context aids, none of the comparisons made in the reading achievement areas of comprehension, vocabulary-in-context, average reading, and context comprehension demonstrated unequivocally the influence of the experimental method.

(2) Though short term instruction in the use of context aids did not differentiate between the experimental and the control groups in a statistically significant manner, there is a suggestion that it is in the area of vocabulary-in-context achievement that the teaching of context aids would be most productive.

(3) In the situation where children were similar in intelligence and background of experience, more of the children who had received instruction in the use of context aids made gains in comprehension than was the case with children who had not received such instruction.

Microfilm $2.75; Xerox $6.60. 137 pages.

THE EXPECTED-ACHIEVEMENT CONCEPT, WITH IMPLICATIONS FOR CURRICULUM AND INSTRUCTION.

(L. C. Card No. Mic 61-1698)

James McCulloch Hutchison, Ed.D.
University of Southern California, 1961

Chairman: Professor Calvert

In the junior high schools operated by the Los Angeles City Board of Education, academic achievement is evaluated with reference to intelligence and chronological age. Basic to this procedure are a formula for obtaining the expectancy age (XA) and tables of expected achievement grade placement (XAGP).

The XAGP Tables establish individual pupil achievement goals. The problem of this study was to appraise the XAGP method of judging individual achievement. The approach was through six questions: (1) What has been the success of earlier attempts to prescribe individual achievement goals by means of formulas based on correlations involving achievement, intelligence, and chronological age? (2) Are correlations involving achievement, intelligence, and chronological age sufficiently high to warrant the establishment of predictions, derived from a regression equation, as individual achievement goals? (3) Apart from the issue of what might constitute a minimum correlation, is one general formula or set of XAGP Tables adequate for

the prescription of individual achievement goals in six specific areas of achievement and in all schools? (4) Do the XAGP Tables treat impartially all pupils regardless of intelligence or chronological age? (5) Is the basic expectancy equation mathematically and logically acceptable as equivalent to the multiple regression equation of achievement on intelligence and chronological age? (6) Do the XAGP Tables provide expectancies which are reasonable in the light of knowledge, logic, and experience?

Examination of the literature was used to answer the first question. For the next three, statistical treatments of empirical data were employed. The last two were answered through critical analysis using mathematics, logic and experience. Data were obtained for four samples of pupils numbering 1237, 1399, 500, and 976. Statistical treatment included computation of coefficients of correlation and correlation derivatives, multiple regression equations, graphic comparison of grade placement curves, t-tests of the significance of differences between means, and chi-square tests of the significance of differences in the success of groups in attaining XAGP.

Findings. The predecessors of XA are generally regarded as unreliable and inadequate. Many statisticians require a correlation of .90 as the minimum for individual prediction. None of the correlations computed in the study met this requirement.

Numerous statistically significant differences were found. No two regression equations were identical. Grade placement curves failed to coincide. The XA equation proved to be different from the regression equation. The XAGP Tables were found to be spuriously precise, to have an arbitrary ceiling, to misuse norms as goals, and to be in need of a standard error of expectancy.

Conclusions. The individual goals established by the XAGP Tables are suspect on several counts. Proof is lacking of the asserted superiority of XA and XAGP over devices which they were intended to replace, e.g., the AQ. Correlations are too low to warrant confidence in using predictions as goals. There is much cause to doubt the universal applicability of one general formula or set of XAGP Tables. The XAGP Tables are partial toward various combinations of intelligence and chronological age. There are mathematical and logical doubts regarding the XA formula. Many goals prescribed by the XAGP Tables are inconsistent with knowledge, logic, and experience.

Recommendations. Some phases of this study should be repeated with new data at the elementary and junior high school levels. Standard errors of expectancy should be empirically ascertained. Meanwhile, caution should be exercised in the interpretation of deviations from XAGP goals and in modifications of curriculum or methods of instruction based upon such deviations.

Experiments should be conducted with other methods of evaluating achievement. For example, tables could be devised showing achievement in deciles for various combinations of intelligence and chronological age, in the manner of Table LIII of this study.

Microfilm $3.70; Xerox $13.05. 286 pages.

THE EFFICACY OF A READING READINESS PROGRAM WITH THE EDUCABLE MENTALLY RETARDED

(L. C. Card No. Mic 61-1628)

Laura Josephine Jordan, Ph.D.
University of Illinois, 1961

The purpose of the study was to compare the progress of educable mentally retarded children given an experimental reading readiness program in a special class setting with that of children of comparable ability remaining in the regular grades. The experimental sample consisted of all of the children enrolled for the first time in the first grades of a number of school districts, who earned Binet IQ scores in the range of 60 to 85. The total sample was randomly divided into an experimental and a control group. The experimental subjects were placed in special classes for the retarded established for that purpose, while the control children remained in their first grade placements with no alteration of program.

The experience approach to reading was chosen for the experimental readiness program, while a basal reader series was used in the regular grades. The experimental reading materials were developed from chart stories recounted by the children about their own experiences.

Reading and cognitive tests were used as the criteria of achievement. The reading tests, administered at the end of the school year, were three subtests of The Harrison-Stroud Reading Readiness Profiles, and the Lee-Clark Reading Test for primer and grade one. The cognitive tests, administered twice, were the Stanford-Binet Intelligence Scale, Form L, the 1937 revision, and the SRA Primary Mental Abilities test for ages five to seven.

After a training period of approximately seven months, the control group scored consistently and significantly higher than the experimental group on both of the standard reading tests. Inclusion in the experimental or control group was more closely related to success on the reading tests than was the original tested IQ.

Gain scores were computed for the cognitive tests. On the Stanford-Binet, the IQ gain of both groups during the training period was high, and not significantly different. The mean gain was about 8 IQ points for the experimental, about 6 IQ points for the control children. When these two groups were subdivided into those scoring at or below IQ 75 on the Stanford-Binet, and those earning higher scores, the experimental children in the range of IQ 60 to 75 had gained significantly more than the control children of the same range. The gains of the more able children of both groups did not differ significantly. The experimental program appeared to have positively influenced the gain of the initially less able children, while the more able gained no more than their counterparts in the regular grades.

Examination of the test protocols showed qualitative differences in the way in which either group had made its gain, the experimental children having earned more points on items which seemed to require greater exercise of verbal and reasoning skills than did those items on which the control children made their greatest improvement.

On the Primary Mental Abilities test, the mean IQ gain of the experimental children was about 15 points, and that of the control children about 16 points. The experimental children scored significantly higher on the Verbal, and the

control children on the Perceptual, score. The experimental children who had earned a Binet IQ above 75 had gained significantly more than their peers in the Verbal score, the only difference.

It was concluded that school attendance supplies needed stimulation to young retarded children, accounting for the general rise in ability to score on the cognitive tests. The experimental reading program resulted in lower ability to score on standard reading tests, but appeared to give promise of greater future gains if continued over a longer period, especially for the children with an initial IQ below 75. Microfilm $2.75; Xerox $8.60. 187 pages.

AN ANALYSIS OF REPRESENTATIVE MAJOR CRITICISMS OF EDUCATION IN THE PERIODS 1930-1939 AND 1950-1959

(L. C. Card No. Mic 61-1323)

Halldor Carl Karason, Ph.D.
University of Washington, 1960

Chairman: Homer Boroughs, Jr.

The purpose of the study was, primarily, to determine whether there was any demonstrable difference between selected representative critics of education in the 1930's and the 1950's in respect to their statements about the purpose of education, their criticisms of education, and their suggestions for reform; second, to determine what implications for American education might be suggested from such an analysis; and third, to identify socio-economic and other factors which seemed to have influenced opinion about education.

The major sources of data for the study were books, published in the two decades 1930-1939 and 1950-1959, which were critical commentaries on education. More than ninety books were examined for the initial consideration. The final selection of books for the study was guided by the following criteria: (1) that the book had received some recognition nationally; (2) that the book was a serious discussion of educational problems; (3) that the discussion of education was broad in scope; (4) that the total selection of books represented a chronological sample for both decades; (5) that there was some representation of the opinions of professional school people, i.e., teachers, administrators, and professors, and also some representation of lay opinion. Forty-seven books were finally selected for use in the study. Of these, twenty-three were published in the 1930's and twenty-four in the 1950's. In most cases two, in some cases more, books were selected for each of the years in the two decades.

The statements of the purpose of education fell into three categories, viz., (1) social reform, (2) conservation of social values, (3) intellectual and personal development. It was found that there was a definite shift away from social reform as the purpose of education in the 1950's, and a greater emphasis on intellectual and personal development than was evident in the 1930's.

The critics in both periods stressed the need for reorganization of the school program, but the suggestions of the 1950's were more specifically concerned with providing for the able and gifted student than were the critics of the 1930's.

Progressive education was not a serious issue with the critics of the 1950's as it had been in the 1930's. The tendency of the critics of the 1950's was to use progressive education as a straw man.

In both decades there was agreement on the need for federal aid to education. In the 1950's there was substantial agreement that equalization of opportunity in American schools could not become an actuality without federal aid.

Teacher training programs were more vigorously attacked in the 1950's than in the 1930's. The emphasis in the 1950's was that there was too much time devoted to methods courses in teacher education, and that there was an excessive proliferation of Education courses. There was considerable agreement that teachers should have a broad liberal arts training as well as professional training for teaching. Internship as a part of teacher training was stressed in the 1950's as was the need to increase teachers' salaries.

There was more general agreement in the 1950's than in the 1930's on the desirability of citizens' commissions at local, state and national levels. These commissions were to function in an advisory capacity and were not to take over the functions of local school boards or state boards of education.

In both decades it was found that the critics related their discussions of education to the socio-economic problems of the time. In the 1930's it was the Great Depression and its accompanying social and economic problems, and in the 1950's it was the cold war, communism, and the general state of world tension with the accompanying threat to world peace and to the security of the United States.

The findings suggested that in the thinking of the critics of the 1950's there was a need for greater emphasis on the following:

1. the academic disciplines at all levels.
2. liberal arts training in teacher education programs.
3. scholarships, including national scholarships, for able students.
4. flexibility in school programs to provide for differences in ability at all levels.
5. public participation in educational policy making through citizens' commissions at local, state, and national levels.
6. professionalization of teaching by strengthening teacher training programs, increasing teachers' salaries, and encouraging more highly competent people to enter the profession.
7. federal aid to education to provide for equalization of educational opportunity on a national scale.

Microfilm $4.95; Xerox $17.55. 387 pages.

READING SCIENCE MATERIALS FOR TWO SPECIFIC PURPOSES AT THE SIXTH GRADE LEVEL

(L. C. Card No. Mic 61-1631)

Paul William Koester, Ed.D.
University of Illinois, 1961

Problem

The purpose of this study was to investigate the following relationships which existed (1) among measures (one comprehension and three rate scores) of ability to read expository science material for a specific purpose, and (2) among measures of purposeful reading (comprehension and rates scores) and measures of (a) intelligence, (b) science achievement, (c) general reading abilities, (d) reading for problem solving in science, and (e) reading behaviors associated with purposeful reading.

Procedure

Fifty students in two sixth-grade classes within the same school were divided into two equated groups on the basis of intelligence-quotient scores. Standardized tests were administered to both groups to obtain measures of general reading abilities, science achievement, and ability to read for problem solving in science.

By holding measures of intelligence quotients constant by means of the t test of significance of difference between means for equated groups, no significant difference was found between the two groups in all measures derived for the administered standardized tests.

The author developed two tests of purposeful reading called Purposeful Reading of Science Materials. Each of the two tests consisted of the same series of twenty different expository science passages. Every passage described how to perform an experiment and explained how a particular phenomenon occurred. Each passage was followed by two multiple-choice items. Group A was asked to read the passages to understand the step-by-step directions; Group B was directed to read to find the best explanation for an event. The passages were administered at the rate of two each day for ten successive school days. These purposeful reading tests provided a comprehension score and three rate scores.

Two sixteen-item checklists were used. On one checklist each student recorded his self-perceived reading behaviors; on the other, the student indicated his perception of an ideal reader's behaviors.

The t test of significance of difference between means for equated groups was used to test the differences in the mean scores of original reading time for the two groups. All relations between measures of purposeful reading and measures derived from standardized tests were analyzed in terms of product-moment correlations. The responses to the two checklists were reported and compared in terms of the proportion of the total groups' responses for each alternative of each checklist item.

Findings

1. The purpose of reading did not significantly affect the rate of initial reading time.
2. The fast readers were not necessarily the best readers in terms of comprehension.
3. Readers with high non-verbal intelligence scores tended to have high comprehension scores on the tests of purposeful reading. Measures of intelligence were not good predictors of rate.
4. Readers with high science achievement scores tended to achieve best in purposeful reading comprehension but not in reading rate.
5. Readers who excel on one test of reading comprehension tend to excel in other tests of reading comprehension.
6. The superior readers in terms of comprehension may not be superior readers in terms of reading rate.
7. Readers who read rapidly for one purpose may not be the fast readers when reading for other purposes.
8. Reading rate, strategy, and accompanying behaviors are influenced by the purpose for reading.
9. The sixth grade readers tended to manifest rigidity in reading procedures irrespective of the purpose in reading at a constant rate, starting with the first word, and reading word for word.
10. The sixth graders were confused as to what specific behaviors characterized an effective purposeful-reading pattern. This confusion was shown by the discrepancies of ideal-reading behaviors. The Superior Readers in the study were less sure of what practices constituted superior reading procedures than were the Inferior Readers.

Microfilm $2.90; Xerox $10.15. 223 pages.

BEHAVIORAL RIGIDITY AND COLLEGE PHYSICAL SCIENCE INSTRUCTION

(L. C. Card No. Mic 61-1708)

James Thomas Shockley, Ph.D.
University of Southern California, 1961

Chairman: Professor Olson

Some individuals attack problems in several ways, while others fail to do so even when their efforts yield unsatisfactory results. Those persons who manifest little variety in problem situations seem to cling to previously established behavior patterns to such an extent that they refuse to form new patterns when these are appropriate. Psychologists have used the term behavioral rigidity to describe the actions of such persons. The hypotheses tested in this study are based upon two ideas of Schroder and Rotter concerning the nature of rigid behavior. According to the first of these, rigidity is due to an inclination to limit attention to a few cues in a problem situation and to expect that only one avenue will lead to a solution. The second idea holds that flexibility, the opposite of rigidity, is the result of learning to notice many cues and to anticipate that problems may be solved in more than one way.

The objectives of this investigation were twofold: (1) to determine whether or not behavioral rigidity influences outcomes of physical science instruction for a sample of students representative of the nonscience majors at Fresno State College and (2) to ascertain whether or not homework assignments consisting of multiple-approach problems facilitate greater gains in two educational skills and in flexibility than homework assignments of

the usual type for samples of students from the same population.

To attain the first objective the Schaie Test of Behavioral Rigidity was used to obtain a rigid and flexible group in one physical science class of ninety students. Students in these two groups were compared on several instructional factors by analysis of variance and covariance. The second objective was approached by separating two physical science classes into control and experimental groups by means of a random numbers table. Control groups were assigned conventional homework problems for one semester, whereas experimental groups were required to do homework designed to bring about shifts in problem-solving set. Control and experimental groups were compared on instruments of measurement and evaluation by analysis of variance.

Findings. Evidence obtained in the first part of this study indicates that flexible subjects significantly excelled rigid subjects in critical thinking, skill in applying principles of physical science to new situations, and over-all achievement. However, when adjustments were made statistically to compensate for background knowledge and skills and aptitudes in favor of the flexible group, only in the case of critical thinking did a significant difference remain.

The second part of the investigation disclosed that subjects who received homework assignments of problems requiring shifts in problem-solving set were no more successful in applying principles of physical science to new situations than were subjects who received homework of a conventional nature. Assignments of problems encouraging shifts in approach likewise produced no greater gains in critical thinking and flexibility than assignments of the usual type.

Conclusions. Assuming no factors other than those considered were operant, the evidence supports the following conclusions. (1) Flexible students excel rigid students in critical thinking, course grades in physical science, and skill in applying principles of physical science to new situations. (2) Assignments of multiple-approach homework problems have no more influence upon critical thinking, skill in applying principles to new situations, and behavioral rigidity than assignments of conventional problems.

Implications for Education and Further Research. This study suggests that behavioral rigidity tests may be useful predictors of success in various educational programs. It also implies that subsequent research may be directed profitably to rigidity tests, the correlates of behavioral rigidity, and the effect of classroom conditions and instructional methods upon behavioral rigidity.

Microfilm $2.85; Xerox $9.90. 217 pages.

THE ACADEMIC ACHIEVEMENT OF ACADEMICALLY TALENTED STUDENTS

(L. C. Card No. Mic 61-1790)

Frederick Robert Smith, Jr., Ph.D.
University of Michigan, 1961

It was the purpose of this study (1) to discover the extent to which Michigan high schools accredited by the North Central Association of Colleges and Secondary Schools were providing educational programs especially designed for academically talented students; and (2) to compare the academic achievement of academically talented students participating in programs especially designed to meet the needs of academically talented students in selected Michigan high schools with the academic achievement of academically talented students not enrolled in these programs.

An academically talented student was defined as that student who is in the upper 25 per cent as measured by a general intelligence test or by a combination of the verbal and numerical scores from an aptitude battery. This is an I.Q. of 110 (108 on the Otis test) or a percentile rank of 75 or above.

A questionnaire was sent to each of the 282 Michigan high schools accredited in 1959 by the North Central Association in order to obtain information concerning special programs for academically talented students. Of the 244 schools responding, 175 reported special provisions for academically talented students and provided extensive data concerning the nature and extent of the special programs.

Four schools having special programs were selected for the evaluative phase of the study. Three types of special programs were considered in the four schools, i.e., grouping with acceleration, grouping with enrichment, and homogeneous grouping with no special methodology. Ten groups of students enrolled in special programs, and ten corresponding control groups not enrolled in the special programs were identified and compared in ability and previous academic achievement prior to the special programs. The groups were also compared on academic achievement following instruction in the special programs for the experimental groups.

The major hypothesis of the study was that academically talented students enrolled in programs especially designed for academically talented students in four selected secondary schools will attain significantly higher scores on appropriate subject tests of the Sequential Tests of Educational Progress than will academically talented students in the same schools who were enrolled in the usual college preparatory programs.

Subhypotheses were tested in each special program in each school. The findings for one special program, i.e., accelerated mathematics, were found to be significant. at the 1 per cent level of confidence and supported the major hypothesis. Similarly, a special program in accelerated history resulted in a difference in achievement significant at the 5 per cent level of confidence. The finding with regard to the remaining eight special programs did not support the major hypothesis. Consequently, the major hypothesis was rejected.

Major conclusions drawn from this study are:

Identification procedures which employed both subjective and objective criteria in selecting students academically talented in individual subject areas appeared to be the most effective and desirable identification procedures encountered in these schools.

There was no indication that the academic achievement of academically talented students enrolled in enriched courses designed for academically talented students in these schools was significantly greater than that of similar students enrolled in regular college preparatory courses in the same subjects.

Grouping of students without changing instructional techniques or subject content in the grouped classes was not effective in increasing the academic achievement of

these students when compared with the achievement of similar pupils in the regular college preparatory classes in the same subjects.

Accelerated courses in mathematics and world history were more effective in increasing the academic achievement of academically talented students than either enriched courses or courses which were merely grouped.

It cannot be concluded that the academic achievement of academically talented students enrolled in special programs for academically talented students in these schools was significantly greater than the academic achievement of academically talented students enrolled in the regular college preparatory courses in these schools.

Microfilm $3.30; Xerox $11.50. 253 pages.

ENGINEERING

ENGINEERING, AERONAUTICAL

COMPRESSIBILITY EFFECT ON THE LOW REYNOLDS NUMBER FLOW IN A SECTOR THRUST BEARING

(L. C. Card No. Mic 61-1692)

Kaoru Toba, Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: Edward Saibel

The specific problem in this investigation is the study of the compressibility effect on the flow with low Reynolds number and low Mach number of a thrust bearing with side leakage. The governing differential equation is linearized by assuming an isothermal process and that the density varies but the kinematic viscosity remains constant. To understand the flow completely a special geometry of the bearing with a step is chosen to allow an exact solution over the range of the parameters involved.

It is noticed that for small film thickness deviation from the continuous medium such as the slip flow phenomenon may be encountered irrespective of the absolute magnitude of the flow density.

When the Knudsen number, which is a measure of this phenomenon, is small the flow may still be treated macroscopically. The formulation can be extended so as to include the Knudsen number as well as the already existing important parameter $\mu\Omega/p$, where μ is the viscosity, p the pressure, and Ω the angular velocity of the bearing. Those parameters are sensitive to the ambient conditions so that the effects of the ambient temperature and pressure on the performance of the bearing are evaluated.

For an incompressible fluid, the Knudsen number reduces to zero. The governing differential equation becomes somewhat more tractable. By assuming a liquid having the same viscosity coefficient, the performance of the bearing for an incompressible lubricant is also evaluated and compared with that for a compressible lubricant over a range of the important physical parameters.

Microfilm $2.75; Xerox $3.00. 54 pages.

ENGINEERING, AGRICULTURAL

MECHANICAL DAMAGE TO PEA BEANS AS AFFECTED BY MOISTURE, TEMPERATURE, AND IMPACT LOADING.

(L. C. Card No. Mic 61-1958)

John Spencer Perry, Ph.D.
Michigan State University, 1959

An experimental procedure of dropping samples of pea beans was developed to investigate the effect of moisture, temperature, and height of drop on mechanical damage. The ranges of the variables selected were limited to those normally encountered in the commercial handling of pea beans. The data indicated that damage, consisting of splits and checked seed coats, was about proportional to height of drop up to 45 feet and that damage was reduced considerably at higher temperatures and higher moisture contents. The experimental dropping technique paralleled a customary commercial handling procedure so that the trends in damage observed can be expected to have some applicability to commercial conditions. The data obtained represent minimum values of damage that can be expected under commercial handling conditions.

Other factors that may influence damage to pea beans were investigated. An increase in damage was associated with an increase in size. Pea beans with checked seed coats developed many times more splits than similar beans with no checked seed coats. Limited, but rapid drying of damp beans did not increase damage during subsequent experimental dropping. Dampening dry beans restored the ability of beans to resist damage from dropping with rate of dampening being an influencing factor.

Germination tests indicated that beans experimentally dropped, but free of all visible damage, had reduced germination. Greatest reduction was associated with low temperatures and low moisture contents.

Some of the kinetics of impact of individual beans were studied by striking prepositioned individual beans with a wooden-faced striking bar at a normal commercial dropping velocity and recording the resulting impact with a high speed motion picture camera. The photographically recorded data were analyzed to determine relative velocities, deformations, and times of impact. Values for the total maximum force, as well as the kinetic energy dissipated at impact were established. Deformation was largely elastic in nature under the impact loadings observed.

The total kinetic energy of the experimentally dropped pea bean samples at impact was established by the use of the high speed motion picture camera.

Microfilm $2.75; Xerox $7.20. 151 pages.

ENGINEERING, AUTOMOTIVE

WHEEL SINKAGE IN SOIL

(L. C. Card No. Mic 61-1736)

Ira Robert Ehrlich, Ph.D.
University of Michigan, 1961

By use of Bekker's equation which relates soil pressure vs. plate sinkage an equation for wheel sinkage vs. loading is developed. The solution is limited to wheel performance at which no slip occurs.

The derivation assumes that no "bow wave" is generated ahead of the wheel, no elastic re-bound occurs behind the wheel to support it, the vertical life pressure along the front face of the wheel is according to Bekker's equation, no side frictional or tractive effort produces lift forces, no dynamic effects, and no side-wall or bottom effects.

The experiments conducted uses a unique soil bin dynamometer in which to conduct the wheel-soil tests as well as unique soil handling equipment.

Tests are conducted in dry silica sand, Bentonite clay, and Michigan sandy loam topsoil. These tests indicate that Bekker's equation can be employed to predict accurately wheel sinkage in a wide range of soils and for a wide variety of wheel shapes and sizes.

Discrepancies were observed in the prediction of wide wheels at small sinkages due to the elastic rather than plastic performance of soils at small deformations. Care must therefore be exercised in the employment of scale models to account for these variations.

Microfilm $2.75; Xerox $5.80. 120 pages.

ENGINEERING, CHEMICAL

THIRD COMPONENT INTERACTIONS WITH THE URANIUM-BISMUTH SYSTEM

(L. C. Card No. Mic 61-1715)

Richard Earl Balzhiser, Ph.D.
University of Michigan, 1961

Third component interactions with uranium in liquid bismuth solutions were studied using two different reactions. The first expressed the equilibrium occurring along the liquidus: $\underline{U} + 2Bi \rightarrow UBi_2$. The second involved the equilibrium decomposition of UC_2 in a bismuth solvent: $UC_2 \rightarrow \underline{U} + 2C$. Copper and palladium both depressed liquidus uranium concentrations at 600°C. Semi-quantitative studies at 600°C revealed that rhodium, cerium, lead and nickel produced decreases in the uranium concentration, while sodium was observed to produce an increase. Copper decreased the equilibrium uranium concentration in the carbide decomposition, whereas palladium increased it at 800°C. The interaction effects were evaluated in terms of Wagner's interaction coefficient,

$\epsilon_2^{(3)} = \frac{\partial \ln \gamma_2}{\partial N_3}$. $\epsilon_U^{(Cu)}$ was found to equal + 11.0. $\epsilon_U^{(Pd)}$ was evaluated as -4.8.

A precise determination of the U-Bi liquidus was accomplished over the temperature range 400°-800°C. The uranium concentration can be expressed as: $\log_{10}$ wt % U = $3.272 - \frac{2690}{T°K}$. No break in the curve was observed over this temperature range. The partial molar enthalpy change for uranium in the liquidus reaction, $UBi_2 \rightarrow \underline{U} + 2Bi$ was found equal to 12,300 cal/gm. mole. The activity coefficient of uranium in bismuth was determined as 1.22×10^{-4} at 800°C from UC_2 decomposition data.

Microfilm $2.75; Xerox $5.80. 119 pages.

SOLUTION AND BULK PROPERTIES OF SOME ARTIFICIALLY BRANCHED POLYVINYL ACETATES

(L. C. Card No. Mic 61-1718)

Guy Curtis Berry, Ph.D.
University of Michigan, 1961

The bulk and solution properties of some artificially branched polyvinyl acetates have been studied. The branched polymers have been obtained by a graft polymerization of vinyl acetate in the presence of narrow molecular weight fractions of linear polyvinyl acetate and a chain transfer solvent. The concentration of the chain transfer solvent relative to the monomer was used to vary and control the average molecular weight of the branches being grafted onto the linear backbone polymer.

The solution properties of the branched polymer have been examined in thermodynamically good solvents. It has been found that the branched polymers studied here are relatively more expanded in solution than linear polymers of the same molecular weight. In particular, if the ratio of the mean square radii of branched and linear polymers of the same molecular weight is defined by the parameter g in a thermodynamically ideal solvent, then this same ratio would be about $g^{1/3}$ in a good solvent.

The effect of branching on other parameters such as the intrinsic viscosity, the second virial coefficient, and the Huggins k' coefficient have been studied. It has been found that the first two parameters can give useful measures of the extent of branching provided some allowance is made for the different degrees of expansion of the branched and linear polymers in solution. The Huggins k' may give a qualitative indication of the presence of branching for some types of highly branched structures, but it does not appear that a quantitative measure of the degree of branching can be obtained from the k' coefficient.

The melt viscosity of the branched polymers has been determined as an important bulk property of these macromolecules. The melt viscosity of the branched polymers was found to be strongly dependent on the length of the branches. The ratio of the melt viscosities of branched and linear polymers of the same molecular weight appears to vary directly with the molecular weight of the branches. The ratio is unity for some critical molecular weight that is characteristic of the particular mers that make up the polymer. This critical molecular weight corresponds to the length of a polymer chain that would be engaged in an entanglement with one other molecule in the melt. Thus, the effect of the branches on the melt viscosity appears to

be related to the ability of the branches to engage in intermolecular entanglements. If they can do this, then they seem to increase the amount of coordination between the various molecules in flow, and by thus increasing the resistance to flow, they increase the melt viscosity. If they are not long enough to engage in entanglements, then they appear to act as internal plasticizers, thus reducing the melt viscosity of the branched polymer.

Microfilm $2.75; Xerox $8.20. 178 pages.

THE SEPARATION OF AQUEOUS TWO-SALT SOLUTIONS IN HORIZONTAL THERMAL DIFFUSION COLUMNS: THE SYSTEM $CuSO_4$-$CoSO_4$-H_2O.

(L. C. Card No. Mic 61-1478)

Gerald Thomas Fisher, Ph.D.
The University of Tennessee, 1960

Major Professor: John W. Prados

The objectives of the investigation were 1) to design, construct, and operate Von Halle-Jury thermal diffusion columns for the separation of a convenient salt mixture, 2) to compare the heights of a transfer unit and the equilibrium coefficients for the separations with estimates from Soret (single thermal diffusion stage) data, 3) to determine the effect of certain operating variables, such as length, width, and temperature difference, on these separation parameters, and 4) to develop a design procedure for commercial separation processes, including columns in a cascade.

Two horizontal thermal diffusion columns were constructed and operated using solutions of $CuSO_4$-$CoSO_4$-H_2O of concentrations 0.5 molar in each salt. The smaller of the two columns was 22-3/4 in. long, 3/4 in. wide, and 1/16 in. deep in each flow channel, with a total mass transfer area of 0.106 ft^2. The larger column had a flow channel 22 ft. long and 1/2 in. wide; it had a mass transfer area of 0.915 ft^2. A du Pont PD-600 cellophane membrane separated the two flow channels in each column. The columns were operated with flow rates between 2 and 30 ml/hr, with the wall temperatures maintained at 40°F and 140°F, and 52°F and 122°F, on the top and bottom, respectively. Both columns were operated with a product withdrawal using two-salt solutions.

The following results were obtained from the small column. The equilibrium constant K for mass transfer equilibrium between the two channel sections was estimated to be 0.944 for the separation of $CuSO_4$ from H_2O and 0.962 for the separation of $CoSO_4$ from H_2O. The corresponding separation factor, α, for $CuSO_4$ relative to $CoSO_4$ is 1.02. The heights of the transfer unit, h_L, based on the cold side compositions and flow rates were estimated to be 0.26 ft for $CuSO_4$ and 0.24 ft for $CoSO_4$ from H_2O at a flow rate of 2.0 ml/hr. The heights of the transfer unit were estimated from Soret data and the theory of laminar operation for these operating conditions, and the corresponding values were 0.91 ft for the $CuSO_4$ and 0.78 for the $CoSO_4$. The salts always concentrated near the cold wall under steady-state conditions and the concentrations of the salts for the cases of maximum separation were 0.367 molar and 0.511 molar for the effluents from the hot and cold sides, respectively.

From the large column, the separation parameters of K and h_L were measured at steady state. The observed values could be correlated with the values observed from the small column using the form of the equations developed under the assumption of laminar flow. These correlations were in error by no more than 10 per cent.

An unusual and unexplained transient concentration distribution was observed when the large column was first started up. The salt initially concentrated at the hot wall, and the concentration continued to vary with time over a long period (about 40 days). After the column finally reached a steady state of operation, the flow rates were changed, and the transient behavior was not observed; the column was not shut down between changes of the flow rates.

The design of a commercial-scale operation for separating a component from a given two-salt mixture is considered in an Appendix using data and theory from this investigation. The separation would be carried out in horizontal thermal diffusion columns arranged in a cascade. Calculations based on data for the $CuSO_4$-$CoSO_4$-H_2O system indicate that in order to change the ratio of salt compositions by a factor of 10, about 3×10^5 square feet of thermal diffusion surface area would be required per pound of dry salt product per day.

The conclusions of the investigation were that 1) the horizontal thermal diffusion column can be used for separating the salt mixtures but would be extremely expensive, 2) the height of the transfer unit is proportional to the flow rate for the conditions investigated, 3) the separation of each salt from water is independent of the presence of the additional salt, 4) the theory developed based on Soret cell separations fails to predict the column behavior quantitatively, although the equations predict the correct dependence of heights of a transfer unit and equilibrium constants on operating conditions, and can be used for scale-up.

Although the laminar flow model may be useful for preliminary estimation of the behavior of a thermal diffusion column, it is necessary to obtain data on a scale model column in order to design a commercial plant for a specific separation with confidence.

Microfilm $2.75; Xerox $8.00. 172 pages.

A STUDY OF CONSECUTIVE COMPETITIVE REACTION SYSTEMS

(L. C. Card No. Mic 61-1738)

Morton Harold Friedman, Ph.D.
University of Michigan, 1961

Experimental kinetic data are most conveniently correlated by the integrated form of the differential rate equations which the reactions are presumed to obey. The rate equations will generally not be integrable if the reaction set which they are to describe is at all complex. A method of obtaining an approximate integral solution, at least partially consistent with the differential equations, is applied to a set of three consecutive competitive reactions; this set may be represented generically by the following equations:

$$A + B \xrightarrow{k_1} P_1$$

$$P_1 + B \xrightarrow{k_2} P_2$$

$$P_2 + B \xrightarrow{k_3} P_3$$

where k_1, k_2, k_3 = rate constants for the reactions.

Four differential equations can be written, describing the rates of disappearance of A, B, P_1 and P_2. To date, the integrated solution of these equations has been found only for particular values of the rate constants and initial concentrations. By dividing one rate equation into another, equations useful for correlation can be derived; these describe the distribution of converted A among the three products. The approximate integral expression for the concentration of A, when no products are initially present, is

$$[A] = [A]_\circ \exp\left[\frac{[B]_\circ}{[A]_\circ b}\left(e^{-bk_1[A]_\circ t} - 1\right)\right]$$

where [ ] = concentration

$[A]_\circ$ = initial value

t = time

and b is a function of the rate constants of the three reactions.

The approximate integral solution is used to correlate experimental and published data on systems whose stoichiometry obeys the chemical equations above. The experimental systems studied include the chlorination of benzene, the hydrofluorination of carbon tetrachloride, ethylene oxide and propylene oxide addition reactions, and the chlorination of propylene. Except for the Freon synthesis, which probably is a free-radical reaction, the compositions of the reaction mixes are predicted with a standard error of estimate of less than four per cent of the initial concentration of A: in three cases, less than two per cent. The estimates of the rate constants, found by fitting the approximate solution to the data, are within experimental error of the values obtained by differentiation of the published results.

Two methods of reactor design, applicable to both batch and continuous systems, are considered: numerical and analytical. In each case, the integral approximation is used to describe the total production cost as a function of the design and operating variables. In the numerical treatments, the values of the independent variables are adjusted until the cost is minimized; when analytical methods are used, equations in the independent variables are derived, the roots of which are the best values of the design parameters. The numerical approach is used to design reactors to produce monoethanolamine from ethylene oxide and ammonia, and acetanilid from aniline and acetic acid. The results of the former design are checked against the optimum found from the direct solution of the rate equations; the results of the latter design are compared to those obtained from an analytical treatment of the integrated rate equations for a single reaction. Excellent agreement is obtained in both comparisons. The possibility of injecting additional B downstream from the reactor inlet to reduce the production cost in the above syntheses is investigated and discarded.

A generalized description of the method used to obtain the approximate integral solution is included, and the use of digital computation to correlate and apply kinetic data is discussed.

Microfilm $3.25; Xerox $11.50. 251 pages.

FINITE DIFFERENCE COMPUTATION OF NATURAL CONVECTION HEAT TRANSFER

(L. C. Card No. Mic 61-1747)

Jesse David Hellums, Ph.D.
University of Michigan, 1961

The use of finite difference methods for the solution of the partial differential equations describing the conservation of mass, energy and momentum in natural convection was investigated. The great advantage of the finite difference approach is that the idealizations required to obtain analytical solutions are not necessary. The main problems associated with the method are the stability and convergence of the difference equations and the amount of computation required. These problems have retarded the widespread use of difference methods in convection problems which would seem to be warranted by the great advances in computer technology of the last few years.

Explicit difference equations were devised that are stable and that require only moderate amounts of computer time and storage by modern standards. The equations are written in time dependent form and treated as an initial value problem. Starting from a motionless, isothermal initial condition, the velocity and temperature distributions are computed as functions of space and time. The complete transient solution, including the steady state as a limiting condition, is obtained. This time-dependent approach is indicated to be preferable to methods in which steady state is assumed at the outset even if the steady state solution is of primary interest.

The infinite, isothermal, flat plate; and the region inside an infinite, horizontal cylinder with the vertical halves of the wall maintained at different uniform temperatures were chosen for illustrative calculations on an IBM-704 because of the availability of experimental data and analytical solutions as a reference and test for convergence.

The flat plate solution was obtained for a Prandtl number of 0.733. The solution is compared with the short time solution for conduction alone, and with Ostrach's solution for the steady state. The results are in good agreement in both cases. In the intermediate time range the problem has not been solved before so the results represent new information.

The cylinder problem was solved for a Prandtl number of 0.7 and three different values of the Grashof number. An additional solution was obtained for a Prandtl number of 10. The results are brought together by dimensional analysis so that the four solutions permit prediction of heat transfer rates in the cylinder over wide ranges of both parameters. The results are shown to be in good agreement with the experimental measurements of Martini and Churchill.

A discussion is given on the application of finite

difference methods to other problems. The method used in this work applies practically without change to any problem in fluid motion in which the pressure distribution is specified or can be calculated from perfect fluid theory. Eventually the most difficult problems in fluid mechanics and heat transfer will almost certainly be solved by the finite difference approach. This work constitutes a significant step in that direction.

Microfilm $2.75; Xerox $7.80. 168 pages.

HIGH TEMPERATURE TENSILE STRENGTH OF CERAMIC ADHESIVES TO STAINLESS STEEL

(L. C. Card No. Mic 61-158)

Henry Gerard Lefort, Jr., Ph.D.
University of Illinois, 1960

The purpose of this study was to determine some of the fundamental physical characteristics which are related to making glassy-bonded ceramic adhesive-stainless steel joints of high strength for operation between room temperature and 800°F. Composites made from such joints would utilize the ceramic material as a hot exposure structural adhesive.

It was also desired to establish a better understanding of the adherence strength at temperatures up to 800°F. of glass to stainless steel.

The study involved the selection of a suitable test specimen in order to establish reliable strengths of bonded joints over the temperature interval involved. Specimens of type 303 stainless steel were designed for pure tensile testing since this was the simplest and most fundamental strength test and would also furnish a most direct indication of adherence.

The effect of certain variables on the adhesive strength or adherence at test temperatures to 800°F. was determined. These included: metal surface oxidation, concentration of Fe_2O_3 in the adhesive frit, re-use of tensile specimens, temperature, firing times and temperatures, crystallizing the adhesive and annealing the adhesive. Adhesive materials were made up as porcelain enamel type slips. Four glassy frits and one frit which could be crystallized readily were used.

Two types of bond failure occurred during test of ceramic adhesive-stainless steel adherend joints. These failures were designated adhesive failure (at glass-metal interface) and cohesive failure (within the ceramic adhesive layer). For adhesive failures the tensile test method served as a quantitative measure of the adherence of glass to metal at any temperature to 800°F. Such values were considered relative since the size or shape of the tensile specimen was felt to affect the exact value.

Mean tensile strength values of 4600 psi at room temperature and 3000 psi at 800°F. were determined for ceramic type adhesives when used to bond stainless steel. For some specimens, which apparently had a minimum of flaws or discontinuities and which broke above the average or mean, tensile values approached 8000 psi at room temperature and 4500 psi at 800°F.

Preoxidation of the sandblasted stainless steel bonding surface increased tensile strength or adherence by about 20% from the 3500 psi to the 4600 psi level.

Additions of Fe_2O_3 to the adhesive frit to promote or improve adherence did not act to improve it at room temperature (75°F.) but did increase it at 800°F. to some extent (2500 psi to 3300 psi). There was no appreciable change in strength values of preoxidized specimens when they were re-used. Annealing the adhesive, changing the firing time or temperature, prefiring the adhesive before placing tensile specimen halves together, or preoxidizing the metal at various times or temperatures did not act to increase tensile strength or adherence appreciably.

A $PbTiO_3$ base adhesive which could be almost completely crystallized exhibited cohesive type failure and average tensile strengths of 2000 psi at 75°F. and 1000 psi at 800°F. X-ray diffraction studies indicated that the oxides of the metal penetrated the adhesive layer and altered the primary $PbTiO_3$ crystalline phase which possibly could have contributed to tensile strength being near or below 2000 psi.

It was indicated in this study that thermal expansion difference between ceramic adhesive and metal, or the "fit," influenced the mean tensile strength value since the greater this difference the lower the mean value. However, for those specimens of exceptional high strengths (possibly due to a minimum of flaws in the bonded joint) thermal expansion difference was not indicated to be of importance in influencing tensile values or indicated adherence. Microfilm $2.75; Xerox $4.80. 95 pages.

DIFFUSION CONTROLLED REACTIONS IN A LAMINAR BOUNDARY LAYER

(L. C. Card No. Mic 61-1409)

Mitchell Litt, Eng.Sc.D.
Columbia University, 1961

A simple exact solution is obtained to the equations of diffusion and energy for a diffusion-controlled reaction occurring in the laminar boundary layer on a flat plate. The solution assumes that the rapid, irreversible, two-component reaction takes place in a reaction zone of negligible thickness inside the laminar boundary layer. One reactant diffuses inward from the bulk of the solution flowing past the plate; the other diffuses from the plate to the reaction zone. The velocity distribution is assumed to be given by the Blasius solution to the Prandtl boundary layer equations. Applications are to problems of absorption, extraction, dissolution, and combustion.

From these assumptions expressions are derived for rates of interphase transfer and concentration and temperature distributions. The effect of the reaction on the mass transfer is expressed in terms of a reaction factor, F, which is applied to the transfer rate without reaction. The result can be given as:

$$Sh_M = F(0.664\, Re^{1/2}\, S^{1/3}) = Sh_{Mo}F$$

where Sh_M is the mean Sherwood number, and Re and S are the Reynolds and Schmidt numbers, respectively. The expression in parentheses represents the rate of mass

transfer without reaction for a flat plate. Equations and plots are given expressing the variation of F with the concentrations and Schmidt numbers of the reacting species.

An experimental system for investigating the rates of reactions of the above type is described. This system consisted of a water tunnel in which different solutions could be flowed past variously shaped test pieces. Both flat plates and cylinders were used. The reactants were benzoic and cinnamic acids in solutions of sodium and potassium hydroxides.

Data obtained with dissolution in water showed that the Sherwood number followed the predicted relationship with Reynolds number but that the absolute rates of solution were too high by about 50%. This is explained by the failure of the system to conform closely enough to the assumptions of the theory, mainly because the plates were rough. However, by defining the experimental reaction factor relative to the dissolution rate obtained without reaction, reaction factors were obtained which closely followed those predicted by the theoretical solution. Furthermore, the data for cylinders also fit the theory quite well, while some for packed beds obtained from the literature were of the same order of magnitude and followed the same trend, showing that the reaction factor is relatively insensitive to geometry. Thus diffusion rates in reacting systems of complex geometry can be estimated from data on rates of solution obtained in the absence of reaction.

Microfilm $2.75; Xerox $7.20. 152 pages.

THE EFFECTS OF WATER IMMERSION ON THE ELECTRICAL PROPERTIES OF BUTYL RUBBER INSULATION COMPOUNDS

(L. C. Card No. Mic 61-6)

Kenneth William Powers, Ph.D.
Cornell University, 1960

During water immersion many rubber insulation compounds absorb large quantities of water and undergo complete electrical deterioration, while other compounds differing only in minor compounding ingredients remain relatively stable. Furthermore, contrary to expectations rubber insulation compounds fail to reach an equilibrium state after a reasonable period of immersion, but suffer continuing and progressive deterioration. No satisfactory explanation has been offered to explain this somewhat anomalous behavior, nor has much been published dealing with other aspects of this subject.

This work was undertaken to study in some detail the effects of water immersion on a prototype butyl rubber insulation compound with the aim of developing some basic information about the changes occurring during immersion. A further aim of the work was to study and understand the effects of processing, immersion, and polymer variables on the deterioration of the insulation compound during immersion. An important phase of the work involved studies to determine why lead oxides have such a profound beneficial influence on stability.

Dielectric constant, dissipation factor, water absorption, and insulation resistance were followed during immersion of a series of compounds under various conditions. Standard 6" x 6" x .075" test pads were used for the first three measurements. The electrical measurements were made with a General Radio Type 716C Capacitance bridge in a specially designed test cell. Insulation resistance measurements were made with a Kiethley Electrometer and shunt on special samples prepared for the purpose and consisting of a brass electrode sandwiched in the vulcanized rubber.

Studies were made to determine the effects of water on the filler system separate from the rubber, both originally and after various treatments. The original filler (Whitetex clay or a Whitetex clay-red lead oxide mixture) or filler recovered from immersed vulcanized stocks by pyrolysis is hydrophilic and has terrible electrical properties after absorbing less than one per cent of water vapor. Filler recovered from an immersed unvulcanized stock by a solution technique is hydrophobic and its electrical properties are less affected by water than the original filler. Furthermore, the solution recovered Whitetex clay-red lead oxide mixed filler is much more hydrophobic and much less sensitive to water than the solution-recovered Whitetex. This lessened water sensitivity of solution-recovered filler is ascribed to an absorbed polymer layer.

Studies of the immersion behavior of unvulcanized stocks and determination of the molecular weight of polymer recovered from these stocks show that red lead stabilizes unvulcanized stocks (i.e. its effect is not primarily a vulcanization effect) and that polymer recovered from red lead-containing stocks after immersion is molecularly degraded. Microscopic examination of stocks during and after immersion is summarized in a series of photomicrographs which shows that agglomeration and chaining of the Whitetex filler occurs during immersion, but is retarded or even prevented by the presence of red lead oxide in the stock. Other studies show that the changes produced during immersion are not reversed by drying, but that during reimmersion the redried stock rapidly deteriorates to the same state it had reached before redrying. Remilling the redried stock before reimmersion greatly improves stability.

Gum (unloaded) stocks remain stable under all conditions. The studies throughout this work support the main thesis developed, that electrical deterioration during immersion is largely a consequence of the poor electrical properties of the filler when it becomes wet and of the tendency of the filler to agglomerate and form conductive chains throughout the compound. Factors which influence this agglomeration affect compound stability. Red lead oxide stabilizes the stock by promoting selective polymer breakdown at the clay surface. The degraded polymer is adsorbed by the clay to prevent agglomeration and chaining and protect the clay from water.

This paper presents an investigation and explanation of the effects of the following variables on stability of the insulation compound during immersion:

Ionic strength, pH, and temperature of the immersion water.

Cure state and cure time of the compound.

Unsaturation and molecular weight of the polymer.

Filler loading used.

Aging prior to and during immersion.

Soluble salts or polar materials in the compound.

All information supports and can be interpreted in terms of the proposed filler agglomeration theory.

Microfilm $4.70; Xerox $16.65. 366 pages.

GAS ABSORPTION ACCOMPANIED BY IONIZATION OF THE SOLUTE WITH SPECIFIC REFERENCE TO THE SYSTEM SULFUR DIOXIDE-WATER

(L. C. Card No. Mic 61-1329)

David Allen Ratkowsky, Ph.D.
University of Washington, 1960

Chairman: Joseph L. McCarthy

The theory and design principles of gas absorption towers in which the absorption process is accompanied by the reversible chemical reaction of ionization in the aqueous phase has been investigated. Previous methods for the design of such absorption towers were largely empirical, suggesting a need for an adequate theoretical treatment of the absorption mechanism itself. In particular, the method of Vivian and Whitney, applied to the absorption of chlorine by water and the absorption of sulfur dioxide by water, was subjected to re-examination and criticized herein.

Within the framework of the two film concept, a differential equation was derived and solved for gas absorption accompanied by ionization of the solute. A method for tower design was developed by comparing the rate of absorption in a tower where the absorption process is accompanied by ionization to the rate of absorption in a hypothetical tower where the absorption is physical. The method was tested by utilizing experimental absorption tower data for chlorine-water and sulfur dioxide-water and good agreement was obtained between the experimental and the predicted results.

An important feature of the method is that it enables the absorption tower design to be carried out by using well established relationships for physical absorption. It is believed that this method will prove useful in future absorption tower designs.

In the second part of this research, ultraviolet absorption spectrophotometry was used for the evaluation of mean ionic activity coefficients for aqueous solutions of sulfur dioxide. Although the chemical constitution of such solutions is not yet completely elucidated, the best evidence available in the literature from ultraviolet and infrared spectral studies indicates that the simple model proposed by Ley and Konig,

$$SO_2,\ H_2O \rightleftarrows H^+ + HSO_3^-$$

appears to be the most likely.

From this model and experimental data acquired by ultraviolet spectrophotometric measurements on aqueous sulfur dioxide solutions of concentration range 3.27×10^{-3} to 12.6×10^{-3} moles/liter, mean molar ionic activity coefficients have been obtained for the hydrogen and bisulfite ions. These activity coefficients, accurate to 1%, were successfully correlated by a semi-theoretical equation for weak electrolytes.

Microfilm $2.75; Xerox $5.00. 100 pages.

MASS TRANSFER STUDIES IN A PULSED EXTRACTION COLUMN

(L. C. Card No. Mic 61-1333)

Leon Douglas Smoot, Ph.D.
University of Washington, 1960

Chairman: Albert L. Babb

Mass transfer of a dilute solute from the organic phase to the aqueous phase was studied in a two inch diameter pulsed sieve-plate extraction column. It has been shown previously that longitudinal mixing of the solute, commonly called back-mixing, in such a column reduces the efficiency of extraction markedly. To date, however, all mass transfer design data on this type of equipment have been analyzed by neglecting the effects of longitudinal mixing. The purpose of this study was to examine the effects of longitudinal mixing on pulsed column performance and to develop design techniques which include these effects.

The concentration of the solute in the aqueous and organic phases was measured at regular intervals along the column for the systems, methyl isobutyl ketone – acetic acid – water, and 1,1,2 trichloroethane – acetone – water. The effects of pulse frequency, pulse amplitude, aqueous and organic phase velocities, sieve-plate hole diameter, and plate spacing, on the column concentration profiles were determined experimentally in several statistically designed experiments. From these data an apparent extraction efficiency based on the solute concentrations entering and leaving the column was computed excluding the effects of longitudinal mixing. In addition, the actual extraction efficiency based on the measured solute concentration profile was computed. These two unique extraction efficiencies were compared using statistical techniques to test the effects of selected variables. The apparent extraction efficiency and the actual extraction efficiency differed substantially, owing to the effects of longitudinal mixing.

An empirical correlation relating the actual extraction efficiency to the important variables was developed utilizing dimensional analysis and multiple regression techniques applied to the experimental data. The final correlating equation allows prediction of the actual extraction efficiency with an average deviation from experimental values of 20 percent.

A pulsed column model for predicting the concentration profile was expressed mathematically as a set of differential equations in terms of known parameters and an analytical solution presented. The theoretical concentration profile calculated from this model agreed reasonably well with the experimentally determined profile. A solution for a simplified case of the mathematical model where piston flow was assumed to exist was obtained and the results compared both with the experimental results and the results calculated by the model for the case where longitudinal mixing was assumed to exist. The piston flow model was not adequate to explain the experimental results.

Finally, a detailed method for pulsed column design based on the mathematical model which includes the effects of longitudinal mixing was established and programmed for an I.B.M. 650 computer. However, before the method can be considered a general one, much

more experimental data will be required for evaluation purposes. Microfilm $2.90; Xerox $10.15. 223 pages.

THE EFFECTS OF LITHIUM ON STAINLESS AND LOW ALLOY STEELS IN THE TEMPERATURE RANGE OF 250-500 DEGREES CENTIGRADE

(L. C. Card No. Mic 60-2618)

Kermit Edwin Woodcock, Ph.D.
Syracuse University, 1960

This dissertation reports a portion of the liquid metal corrosion studies conducted at Syracuse University under the sponsorship of the Olin Mathieson Chemical Company, Niagara Falls, New York.

An experimental program was undertaken in an effort to obtain consistent data with regard to the compatibility of selected stainless and low alloy steels with molten lithium in the temperature range of 250 to 500°C. A dual objective was to gain some insight into those processes responsible for any observed corrosion changes in the tested specimens of exposure. The materials considered in this study were Stainless steels Types 304, 316, 321, 347, 446, 410 and Low-Carbon Steel C-1008.

Cylindrical corrosion specimens, approximately 1/16 inch x 2 inches were cleaned, weighed and placed in capsules fabricated from the same material as the samples. The capsules, while under an argon atmosphere, were filled with sufficient lithium, (99% lithium, 0.6% sodium, 0.01% potassium, 0.02% calcium, 0.001% iron, 0.06% nitrogen), to insure sample coverage, and sealed.

These capsules were placed in a constant temperature media where they were held at a preselected elevated temperature for periods up to 1429 hours.

With the completion of a corrosion period, the samples were removed and weight and strength changes determined. Structural changes were evaluated through microscopic examination of polished and etched cross sections of the corrosion specimens. The quantity of lithium contained in each capsule was measured and analyzed for compositional changes.

Microfilm $2.75; Xerox $8.60. 189 pages.

HEAT TRANSFER FROM ACOUSTICALLY RESONATING GAS FLAMES IN A CYLINDRICAL BURNER

(L. C. Card No. Mic 61-1818)

William Nelson Zartman, Ph.D.
University of Michigan, 1961

Heat transfer from premixed propane-air flames to the cooled walls of a five-inch diameter, ramjet-type burner was studied with and without flame-generated, acoustically resonating oscillations. The oscillations generated were transverse oscillations, i.e., screeching combustion, of approximately 4000 cps and longitudinal oscillations, i.e., organ pipe, of approximately 350 cps. Bluff-body flameholders with greater than 90 per cent blockage of the free-stream area were used to stabilize the flame from 8 to 18-1/2 inches from the end of the tube. The inlet flow velocity upstream of the flameholder varied from 13 to 18 feet per second.

Local heat-flux densities and local inside wall temperatures were measured with and without combustion at five stations downstream from the flameholder. Flame temperatures were measured by a sodium-line-reversal technique at two of these stations. Flame temperatures were also determined from pressure-drop measurements and a thermocouple traverse of the flame in a lean propane-air mixture. Flame temperatures varied from 1600°F to 2800°F as the propane-to-air ratio was varied in the range of combustible lean mixtures. Local coefficients for convective heat transfer were evaluated using the measured values of heat flux, wall temperature, and flame temperature. The coefficients for heat transfer from the flame could be evaluated only at two stations. However, coefficients for heat transfer without combustion were evaluated at all five stations. In order to calculate flame temperatures at points other than where the flame temperatures were measured, coefficients for heat transfer from the flame were assumed to be proportional to the coefficients measured without combustion.

The sound level and frequency of the oscillations were measured and recorded with a high intensity microphone in the combustion tube upstream of the flameholder. Control of the oscillations was obtained by the use of various flameholders, and by a spray-quench muzzle on the end of the burner. Flameholders that stabilized the flame close to the tube wall were prone to screech. The spray-quench muzzle damped out the longitudinal oscillations.

Profiles of the local heat-flux density and of the flame temperature along the combustion tube are presented. The heat flux density was increased significantly by the oscillations; however, the temperature profiles were not changed significantly. The sonic oscillations had a greater effect on the heat transfer phenomena than on the combustion efficiency. The local coefficients for heat transfer 13-1/2 inches downstream of the flameholder can be represented by the expression

$$\frac{h}{h^*} = 0.044 \frac{P}{P_o} + 1.08$$

The quantity h is the measured, local coefficient for convective heat transfer from the flame at the sound pressure amplitude, P; h^* is the coefficient determined from cold flow measurements and corrected for the change in physical properties due to the combustion; and P_o is the sound pressure amplitude of the stable burner. The limits of accuracy for this correlation are ± 10 per cent. The sound level ranged from 130 db to 160 db, which corresponds to a range in pressure amplitude, P, from 0.0092 to 0.29 psi. The effect of frequency or mode of oscillation on the heat transfer was insignificant.

Microfilm $2.75; Xerox $8.40. 185 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

ENGINEERING, CIVIL

THE MECHANICS OF SQUARE ELBOW LOSSES

(L. C. Card No. Mic 61-1597)

Richard Dean Black, Ph.D.
University of Illinois, 1961

Investigations of the head losses in pipe fittings have covered a wide range of fitting types and sizes. The investigations have shown similarities in the trends of the losses, but the magnitudes of the losses have generally been in poor agreement. Most of these investigations were conducted to determine the head loss coefficients for one or a series of pipe fittings. The loss of pressure and the quantity of flow through the fittings were usually measured in hydraulic model tests and the head loss coefficients were computed.

The head loss in a fitting is usually expressed as a constant proportion of the kinetic energy of the flow through the fitting.

$$h_L = K \frac{V^2}{2g} \qquad (a)$$

where

h_L = head loss in the fitting

K = proportionality constant or head loss coefficient

V = average velocity of flow

g = acceleration of gravity

A type of plugged tee or wye, called a square elbow, was tested in this investigation. The magnitudes of the losses and the causes of the variations in the losses were determined, and methods of analyzing the losses in the square elbow were investigated. Tests were conducted with small models using water as a test fluid. The fittings were machined specifically for the tests and a variety of inlet and outlet pipes were used. The variables tested included the average velocity of the flow, the roughness of the outlet pipe, the ratio of the outlet to the inlet pipe size, the angle through which the flow was deflected or turned, and the position of the plug in the elbow. The discharge was measured gravimetrically; the pressures were measured with manometers; and the velocity distribution was measured with a pitot tube.

The values of the head loss coefficients were computed assuming that the kinetic energy of the flow, computed from the average velocity of the flow, was the true kinetic energy. The results of these computations were quite erratic, particularly with changes in the pipe roughness. Changes in each of the variables tested produced a systematic change in the head loss coefficients; however, difficulties were encountered in comparing the changes in the head loss coefficients of the various series of fittings.

The distribution of the velocity in the various pipes was measured, and the true kinetic energy of the flow was determined from the velocity distribution measurements. The equation for the head loss coefficients was corrected for the true kinetic energy and the head loss coefficients were recomputed. When a correction was made for the true kinetic energy, the results of the tests were consistent and followed reasonable trends.

The effects upon the head loss coefficients of varying the pipe-size ratio, the deflection angle, and the plug position, at values of Reynolds' number above 6×10^4, are all interdependent. The effects of changing one of the variables can not be stated without defining the state of the other two. The effect of increasing the roughness in the outlet pipe was to reduce the head loss coefficients for all of the fittings tested, and the effect of increasing the average velocity or Reynolds' number was to stabilize the effects of the other variables. At low velocities or low values of Reynolds' number the effects of the other variables could not be determined in these tests.

For the range of variables that were tested, no method could be found to describe mathematically the variations in the head loss coefficients. However, the variations in the head loss coefficients were plotted as a function of one or more of the variables.

In conclusion, it seems apparent that the distribution of the velocity within the pipes leading to and from a fitting must be known before the loss in a given fitting may be compared with that which has been determined for another fitting. A simple comparison of the Reynolds' numbers is not sufficient until the relationship between the Reynolds' number and the velocity distribution is also known. The magnitude of the head loss coefficients herein reported might be improved upon by additional testing. However, a study of the variations in the velocity distribution within pipes with changes in the pipe roughness, the pipe size, and the Reynolds' number of the flow would undoubtedly be more fruitful. The results of such a study would remove the lack of continuity between the investigations which have been conducted to determine the head loss in pipe fittings.

Microfilm $2.75; Xerox $8.20. 179 pages.

AN INVESTIGATION OF THE FRICTIONAL CHARACTERISTICS OF MINERALS

(L. C. Card No. Mic 61-1625)

Harry Moore Horn, Ph.D.
University of Illinois, 1961

The frictional characteristics of minerals may have an important influence on the stability of masses of earth and of rock. An investigation was conducted in the soil mechanics laboratory of the University of Illinois to determine what factors affect the frictional properties of minerals commonly found in rock and in soil. The minerals investigated included the massive-structured minerals, quartz, microcline feldspar and calcite, and the layer-lattice minerals, muscovite, biotite, phlogopite, chlorite, serpentine, steatite and talc. Direct shear tests were run on the minerals under various conditions of surface moisture, surface roughness, normal load and rate of sliding. The lubricating ability of various polar and non-polar fluids was studied. In addition, direct shear tests were run under various conditions of moisture on fine Ottawa sand and on powdered muscovite.

The results of the investigation indicate that the application of a fluid to highly polished surfaces of massive-structured minerals increases the frictional resistance that can be developed between surfaces of these minerals. The antilubricating effect increases as the polarity of the

fluid increases but diminishes rapidly as the roughness of the surfaces increases. Fluids act as lubricants when applied to surfaces of layer-lattice minerals. It appears that the highly polar fluids are the best lubricants though this is not always the case. Variations in the rate of sliding between 0.71 and 6.00 inches per minute have no effect on the frictional characteristics of massive-structured minerals. The layer-lattice minerals are affected by the rate of sliding with the frictional resistance increasing as the rate of sliding increases. Moisture variations have no measurable effect on the drained shearing resistance of granular soils composed of massive-structured minerals. The shearing resistance of powdered mica is sensitive to moisture variations with the frictional characteristics being very similar to those of mica sheets.

Microfilm $2.75; Xerox $5.80. 116 pages.

QUANTITATIVE INVESTIGATION OF THE DESTRUCTIVE ENERGY IN TORNADOES

(L. C. Card No. Mic 61-1644)

Gordon Elbert Martin, Ph.D.
University of Illinois, 1961

The tornado is a very complicated natural phenomenon. Because of the difficulties involved in making direct measurements, almost no reliable pressure, temperature or wind velocity measurements are available at any elevation for the destructive regions within severe tornado vortices. Competent scientists have estimated pressure reductions within the vortices of severe tornadoes as large as one-half an atmosphere, and some computations give supersonic wind velocities for the most active region of these vortices. In order to properly interpret the available tornado data, a thorough understanding of the processes involved in the life cycle of a tornado is essential. Such a study must of necessity be based upon much indirect evidence.

This investigation has shown that there are many types of tornadoes, and that tornado statistics are of questionable value due to a lack of reliable data and because of the failure of the data to differentiate between these various types of tornadoes. A severe long path tornado depends primarily upon the latent heat of condensation for its energy as does the hurricane. Many small tornadoes receive very little energy from latent heat and are comparable to large dust devils in intensity. The tornado is a part of a complete spectrum of vortex type storms. Hurricanes, dust devils and related phenomena were investigated because of the availability of relatively larger quantities of reliable data in order to establish concepts applicable to many types of atmospheric vortices. Any theory in regard to tornadoes must be consistent with data from the rest of the atmospheric vortex spectrum. The structures and behavior of hurricanes, tornadoes and dust devils were found to be remarkably similar.

Much of the available tornado data from actual measurements, photographs, field surveys, laboratory experiments and theoretical investigations has been evaluated and compared with data from other natural vortices. Concepts are developed concerning the formation and the life cycle of tornadoes. Theoretical investigations of tornado vortices have required so many questionable assumptions that they are misleading. The extrapolation of theoretical curves beyond the available data has led to the belief that extreme pressure reductions and supersonic winds exist in tornado vortices. Such estimates have led to a fatalistic attitude on the part of the designer and little effort has been made to design tornado resistant structures.

Since a tornado is a relatively rare occurrence, there is little point in designing a tornado resistant structure unless it is designed to withstand any tornado. For design purposes, a severe, long path tornado represents the most serious hazard. A conservative design for tornado safety should be capable of withstanding a simultaneous pressure reduction of 3 in. Hg., a tangential wind velocity of 160 mph, a radial velocity of 120 mph, and a translational velocity of 60 mph. These values give a maximum combined surface wind velocity of 250 mph. This maximum velocity is invariably from a southwesterly direction in Illinois. Microfilm $2.75; Xerox $9.25. 204 pages.

CONSTRUCTION AND PERFORMANCE OF THE GROUTED CUTOFF ROCKY REACH HYDROELECTRIC POWER PROJECT

(L. C. Card No. Mic 61-1675)

John Edward Wagner, Ph.D.
University of Illinois, 1961

For many years engineers have successfully used grout curtains to limit or cut off the seepage of water around and under dams built on rock foundations. When the foundations consisted of granular soils, the seepage problems have been more serious. Under these conditions cutoff generally has been provided by construction of a sheet-pile cutoff wall, or by excavation to bedrock and construction of a cutoff wall of concrete, clay, or other material of low permeability. Alternatively seepage has been accepted, and an upstream impervious blanket either with or without a system of relief wells used to control the seepage within acceptable limits. More recently, control of seepage through granular soils has been attempted by grouting. Many grouting attempts have been unsuccessful, and none of the limited number of successes have been widely reported.

This dissertation concerns the successful construction of a grouted cutoff through an alluvial gravel and sand deposit on the Columbia River near Wenatchee, Washington. The site conditions and preliminary investigations, which indicated that cutoff by grout curtain was necessary and feasible, are described. The construction of the curtain involved the injection of two entirely different types of grouts, cement suspension and chemical, into a heterogeneous deposit of gravels and sands. A detailed description of the grouting equipment and methods, and degree of engineering supervision is given. The engineering and construction problems encountered and the solutions used are recounted.

Construction records were examined to determine the volumes of each type of grout injected, the properties of the grouts, the injection pressures, and the soil properties of the deposit. Also discussed are the results of studies made of these data to determine the effects on the volumes

of grout injected of: soil type and grain size; grout grain size; grout hole depth, spacing, and pattern; sequence of grouting; and injection pressure. The effects of the relative grain sizes of the soils grouted and of the suspension grouts used are discussed in relation to a groutability ratio. The problems which resulted from the use of excessively high injection pressures are described together with the corrective measures adopted to rectify these problems.

The effectiveness of the completed cutoff is evaluated in terms of the observed piezometric elevations upstream and downstream of the curtain. The future performance of the curtain is postulated on the basis of the properties of the grouts injected, the efficacy of the construction methods, the quality of engineering supervision of construction, and the observed performance of the grout curtain to date.

Microfilm $2.75; Xerox $7.20. 155 pages.

ENGINEERING, ELECTRICAL

SINUSOIDAL ANALYSIS OF HYSTERESIS EFFECTS IN NONLINEAR FEEDBACK CONTROL SYSTEMS

(L. C. Card No. Mic 61-1616)

Vembu Gourishankar, Ph.D.
University of Illinois, 1961

Sinusoidal or harmonic analysis is a powerful method of analyzing linear control systems. It may also be applied to nonlinear feedback control systems, by using the concept of describing functions. The describing function of a nonlinear element is the complex ratio of the fundamental component of its output to its sinusoidal input. Harmonics of order greater than one are neglected. The describing function in general is a complex quantity and a function of the amplitude and frequency of the input signal.

As long as the system has only one isolated nonlinear element, this method of analysis is not very difficult. The problem becomes more complicated if there is more than one isolated nonlinearity in the system and the situation becomes worse if one of them is in the forward path and the other in the feedback path of the system. One such system is considered in this thesis.

The nonlinear feedback control system investigated in this thesis has two hysteresis type nonlinear elements, one in the forward path and the other in the feedback path. Linear elements are also present. It is shown that the analysis of such a system in the frequency domain using the Nyquist stability criterion is almost impossible in view of the complexity of the over-all transfer function of the system. It is also pointed out that the analysis of the general case in the time domain leads to nonlinear differential equations which can be solved only by graphical or numerical methods with the help of computers.

A special case, where the feedback signal is small compared to the forward path signal is therefore considered and a method of analysis in the time domain is proposed. This method is a combination of describing function, perturbation and iteration techniques.

The linear and nonlinear feedback elements and the linear secondary feed-forward element are assumed to be zero and the solution of the differential equation of the remaining open loop system containing one nonlinear element is obtained. The linear feedback and secondary feed-forward elements are then introduced in the system, the nonlinear element in the forward path is linearized by replacing it with its describing function and the resulting linear differential equations of the system are solved simultaneously to obtain the output of the system.

The effect of the nonlinear feedback element, whose input is assumed to be the system output calculated in the previous step, is now taken into account by considering a perturbation of the output of the nonlinear element in the forward path by the normalized value of the input to the nonlinear element in the feedback path. This can be done since both the nonlinear elements are of the same kind. The resulting differential equations of the system are solved again simultaneously to obtain the final value of the output of the system.

A direct current generator subjected to sinusoidal excitation in one field winding and another field winding connected in series with the armature, the latter feeding a resistance-inductance load, is used as an example of such a system and the calculated and measured values of steady state response for a given input condition are compared. An analog computer is used to solve the simultaneous differential equations which describe the control system. The calculated and measured values of response are found to be reasonably close.

A method of determining the parameters of the direct current generator used is described and the importance of choosing values of parameters corresponding to the operating signal level is emphasized.

Microfilm $2.75; Xerox $5.20. 105 pages.

THE DETERMINATION OF OPTIMUM PATHS IN THE PHASE PLANE FOR DYNAMIC SYSTEMS USING CALCULUS OF VARIATIONS TECHNIQUES

(L. C. Card No. Mic 61-1621)

Thomas Ivan Hedvig, Ph.D.
University of Illinois, 1961

A new method of optimizing feedback systems is proposed. The method consists of finding optimum paths in the phase plane for the system under consideration which the system is to follow for optimum performance.

Integrals of various error functions in the time domain were chosen as optimizing criteria. Such criteria included, among others, the integral of the error; the integral of the error squared; the integral of the square root of the sum of the error squared plus the square of the first derivative of error with respect to time plus the square of the second derivative of error with respect to time. Various constraints were placed on the system under consideration. Two important examples of these constraints were the following: the energy available for error reduction was compelled to be not greater than a certain constant; the average power available for error reduction was compelled to be not greater than a certain constant.

The input to the system was considered to be an ideal step function.

Calculus of variations techniques were used to find the optimum paths. The constraints and the optimizing criterion were combined into a single integral using the method of the undetermined Lagrange multipliers. The integral was then transformed from the time domain into a phase plane representation. Next the Euler-Lagrange differential equation was found for the integral under consideration. The solution of this Eulerian differential equation in the phase plane gave the desired optimum path. The values of the undetermined multipliers were obtained by substituting the functions obtained into the side conditions.

The Eulerian equation was solved analytically for simple cases. Analog computer solutions were utilized for the more difficult examples. Sets of curves were obtained by changing the numerical values of the side conditions. Curves were obtained in both the error and the output phase plane.

The method was found to be satisfactory not only for linear but also for some nonlinear systems. Various nonlinearities were considered, where the nonlinearities were not functions of time. These included variable friction and acceleration dependent inertia. It was found that for second order systems unique optimum paths could be obtained in the phase plane by using the above discussed method. Microfilm $2.75; Xerox $6.20. 126 pages.

COMPILER SOLUTION OF DIFFERENTIAL EQUATIONS WITH DIFFERENTIAL ANALYZER-TYPE OUTPUT

(L. C. Card No. Mic 61-1951)

Lorn Lambier Howard, Ph.D.
Michigan State University, 1959

Major Professor: L. W. VonTersch

Differential analyzer-type output is available from a digital computer using the techniques described in this paper. In addition, this is made possible in such a way that anyone who needs the solution to an ordinary linear constant coefficient differential equation may obtain it without assistance from programmers or previous knowledge of the operation or programming of either type of computer. The user needs only to convert his differential equation directly into a simple code resembling the actual mathematical statement of the equation, punch this code onto computer tape preceded by the compiler routine developed in this paper, and have results immediately after feeding the tape to the computer. The entire process should require at most only a few minutes.

As with the differential analyzer, the output is a simultaneous presentation of the dependent variable and all of its derivatives as a function of time. A major difference, however, is in the greatly improved accuracy of the results over those available from that type of computer. Another desirable feature, of course, is in the large reduction in the time required to obtain the results.

Both the solution and the differential analyzer-type of output are accomplished without the necessity for the reduction of the differential equation to a series of first-order equations, a procedure which is often required. The standard Runge-Kutta integration procedure is used.

The compiler routine developed herein is prepared especially for the Michigan State University automatic digital computer (MISTIC) but may be used readily where other models of this type of computer are available: Iowa State College, University of Illinois, University of Sydney, Aberdeen Proving Ground. The programming technique, however, is laid out in detail so that the method may be readily adapted to programming for other types of digital computers.

Availability of storage space (1024 positions) limits use of the program to the solution of equations of first through fifth order. A wide variety of combinations of "driving functions" is allowed, however. Provision is made so that experienced programmers may readily modify the routine to add other driving functions as required. Microfilm $2.75; Xerox $4.80. 95 pages.

MAXIMUM POWER TRANSFER BETWEEN LARGE APERTURE ANTENNAS IN THE FRESNEL REGION

(L. C. Card No. Mic 61-2042)

Ernest Jacobs, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Pietro P. Lombardini

The power transfer between two antennas can be predicted in the far field under free space conditions by means of the transmission formula presented by Friis in 1946. For large aperture antennas the minimum separation for which the Friis formula is valid can become rather large due to the far field requirement. The purpose of this paper is to present a method for predicting the power transfer between antennas for shorter separations.

A general power transfer formula is developed with no direct restriction on separation. However, this general formula requires that there be no interaction between the antennas which indirectly limits how close they can be brought together.

In order to use the general power transfer formula for a particular case it is necessary to know the expression of the radiation field of the incoming wave over the receiving antenna's aperture, as well as the field that would be across its aperture in the event it would function as a transmitter. This means that to make a computation, it is required to have the Fresnel region expressions for the pattern of the transmitting antenna in planes parallel to the aperture of the receiving antenna.

The special case of two rectangular aperture antennas directed towards each other is presented. This is normally the position of maximum power transfer. The antennas are assumed to have a uniform phase and separable amplitude distribution across the aperture. The result is expressed in the form of the Friis transmission formula multiplied by two correction factors. Both of these correction factors are a function of the antennas' separation and approach one as the separation approaches the far field boundary. One correction factor depends only

upon the antennas horizontal distributions and the ratio of the dimensions corresponding to these distributions. Similarly, the other correction factor depends upon the same characteristics in the vertical direction.

The correction factors are derived for six combinations of aperture distributions. These factors are numerically computed and presented in both tabular and graphical form.

The results of an experimental program to check the validity of the prediction method presented are given. These results are in very close agreement with the theoretical prediction.

Microfilm $2.75; Xerox $6.20. 126 pages.

THE PENUMBRA REGION OF APERTURE ANTENNAS

(L. C. Card No. Mic 61-2046)

Haralambos N. Kritikos, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Pietro Lombardini

The work of this dissertation is an attempt to evaluate the shadow or penumbra region field pattern of the feed-reflector type antennas.

Following a diffraction theory approach the problem has been formulated rigorously in terms of an integral equation. Two methods of providing the exact solution have been suggested, however, because of their complexity the emphasis has been placed in the development of an approximate method, which is valid for cases where the wavelength is small as compared to the physical dimensions of the system. The special case where this approximate method was applied was that of a feed illuminating a spherical reflector.

The results of this work have indicated that the magnitude of the field present in the penumbra region is equal to the order of magnitude present in the direction of the edges. Microfilm $2.75; Xerox $3.60. 62 pages.

RADIATION FROM A CURRENT FILAMENT ABOVE A HOMOGENEOUS EARTH, WITH APPLICATION TO MICROPULSATIONS.

(L. C. Card No. Mic 61-1367)

Paul Foster Law, Ph.D.
The University of Texas, 1961

Supervisor: Bob M. Fannin

This dissertation presents the solution for the electric and magnetic fields associated with a horizontal line current source above a plane, homogeneous earth. The near field considerations are of primary importance and care has been taken not to include approximations that would mask their effects. Solutions are given in terms of certain Hankel, Bessel, and Struve functions. The fields at the earth's surface are evaluated for a particular set of parameter values. These parameters are chosen to approximate an ionospheric radiating source at a typical micropulsation frequency.

The results of this study indicate that near field considerations give rise to an appreciable vertical component of magnetic field variation at the earth's surface. The downward wave impedance of the homogeneous earth remains, however, substantially that value predicted by a plane wave incidence approach.

Microfilm $2.75; Xerox $3.00. 49 pages.

NEGATIVE-RESISTANCE ELEMENTS AS DIGITAL COMPUTER COMPONENTS

(L. C. Card No. Mic 61-1125)

Morton Herbert Lewin, Ph.D.
Princeton University, 1960

The use of two-terminal negative-resistance devices as the basic elements in a digital system is discussed. Methods are given for determining the composite static V, I characteristic of two or more connected elements, some of which are negative-resistance devices. The load-line construction for determining the equilibrium points of a circuit is generalized to include non-linear, negative-resistance "load curves." Properties of combinational switching circuits are examined to establish allowable modes of circuit operation for the negative-resistance components. The realization of logic gain and maximum repetition rate is also treated.

"Threshold" and "locking" circuits are defined. Both are included in a more general class of circuits which operate in the "bistable-with-reset" mode. It is shown that a time-varying power source is an essential feature of this mode of operation. The need for a multiphase power source is explained. Included also is a discussion of the adaptability to asynchronous operation and the special problem associated with the threshold inverter.

Specific circuits, performing all the fundamental logic functions of a digital system, are presented. All of these utilize a particular, voltage-controlled negative-resistance device, known as the tunnel diode, as the basic element.

The unilateralization problem, arising from the two-terminal nature of the active elements, is discussed. Means for dictating the direction of flow of information in the system are given. The realization of storage functions and sequential switching circuits is also treated. It is shown that dynamic storage is directly compatible with the multiphase power supply approach. Results of experiments with tunnel diode logic circuits are presented. An experimental arithmetic cell constructed using only tunnel diodes and resistors, which was operated successfully, is described in detail.

A tunnel diode-transistor "hybrid" circuit is then derived. It is shown that the negative-resistance elements provide non-saturation operation of the transistors and furnish useful threshold properties. A logic system, using this circuit as the basic gate, is proposed.

Microfilm $3.95; Xerox $13.95. 308 pages.

CRITICAL ANALYSIS OF SPACE-FREQUENCY EQUIVALENCE IN ANTENNA DESIGN

(L. C. Card No. Mic 61-1496)

Bruce Roland Mayo, Ph.D.
Syracuse University, 1960

Many modern electronic systems require antennas with angular resolutions of fractions of a degree and side-lobes which are small compared to the main lobe. A conventional antenna which meets these requirements possesses a large aperture which results in a large power gain, a large cost, and difficult azimuth pointing of the antenna beam. In many applications the power gain of the full aperture is not needed and it would be beneficial to reduce the aperture if unambiguous angular resolution and side-lobe level could be maintained.

This dissertation analyzes the performance of electronic systems using reduced apertures and multi-frequency signals. In particular, the following three arrays are considered: (1) a two-element array using harmonically related frequencies. Signal processing consists of adding similar frequencies in the two elements, then dividing the individual frequencies down to the lowest frequency used, and summing all such signals. (2) a two-element correlation array using arbitrary signal spectrums. The signal processing consists of cross-correlating the output of the two elements. (3) an N-element array using signals of arbitrary spectrum with the outputs of all the elements summed.

The two-element array using harmonically related frequencies is shown to have a pattern equivalent to that of a single frequency array of 2n elements, where n is the number of frequencies employed. However, the pattern holds only for the case of a single received signal and deteriorates seriously for two or more simultaneously received signals.

The two-element correlation array is shown to have a pattern which is of the same shape as the pattern of a single frequency array whose amplitude distribution is the shape of the power density spectrum of the signal used in the correlation array. It also produces spurious outputs when two or more signals are received simultaneously. The nature of these spurious outputs is shown to depend upon the time relationships between the received signals. The signal-to-noise properties of correlators with pulsed signals are analyzed and are shown to produce a decrease in output signal-to-noise ratio for small input signal-to-noise ratios.

The N-element array using broadband signals is shown to be capable of arbitrarily small beamwidths with the sidelobe level varying inversely as the number of elements. The analysis of the N element wideband array based on continuous signals is shown not to apply when optimum processing of wideband signals from a signal-to-noise viewpoint is desired.

Microfilm $2.75; Xerox $6.60. 137 pages.

A-C SERVOMOTOR PERFORMANCE AS INFLUENCED BY PHASE SPLITTING AND OTHER EXTERNAL IMPEDANCES

(L. C. Card No. Mic 61-1550)

Michael George Rekoff Jr., Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Norbert L. Schmitz

The three topics of specific interest are the development of a method to detect the single phasing or nonsingle phasing mode of operation, the development of a method to precalculate the near zero speed damping of a servomotor and its associated impedances, and the outline of design procedures to facilitate the specification of phase splitting networks for obtaining two phase voltages from a single phase source. The method of symmetrical components is used for all analytical developments and computations.

A graphical procedure is presented which divides all possible values of control winding circuit impedance into two groups, those resulting in the single phasing mode of operation and those resulting in the nonsingle phasing mode of operation. This graphical procedure uses only the parameters of the servomotor equivalent circuit and is independent of any external circuit conditions associated with the servomotor.

A second graphical method is presented which allows one to determine the slewing damping exhibited by the servomotor in terms of its own equivalent circuit parameters and the impedances connected into the reference and control winding circuits. Slewing damping is defined as the damping obtained at zero speed when the voltage applied to the control winding circuit is zero and the reference winding voltage is at a prescribed value. The method advanced yields an exact (to the extent that the servomotor equivalent circuit parameters are known) result as compared with the conventional means for determining the damping of the servomotor from the manufacturers torque-speed curves.

Regarding the operation of the two phase servomotor from a single phase source, there are advanced numerous network configurations which will enable one to derive the voltages of different time phase necessary to obtain proper servomotor operation. Since these different phase splitting networks in general depend upon the servomotor power factor at a specified speed to determine their realizability, the range of networks presented is such that one can obtain voltages in quadrature for any practical value of servomotor power factor.

Included in the thesis is a recommendation for the appropriate approximation for the torque-speed characteristics to obtain a linearized servomotor transfer function recognizing the relative magnitudes of the external impedances connected into the servomotor winding circuits.

Several general conclusions are reached regarding the design of phase splitting networks, the specification and improvement of system damping and the specification of servomotor equivalent circuits. These conclusions have either not appeared in the literature or are contrary in some respects to what has appeared.

The thesis concludes with a FORTRAN listing for all of the digital computer programs used in its development

and with a tested scheme for obtaining the servomotor equivalent circuit.

Microfilm $2.95; Xerox $10.35. 226 pages.

SYNTHESIS OF ACTIVE RC NETWORKS

(L. C. Card No. Mic 61-1269)

Jack Myron Sipress, D.E.E.
Polytechnic Institute of Brooklyn, 1961

Adviser: Ernest J. Angelo, Jr.

The synthesis of active RC networks, i.e., networks containing only resistance, capacitance, and active elements, is examined. Synthesis procedures are presented which establish that one grounded 3-terminal negative impedance converter, embedded in an unbalanced grounded RC network, is sufficient to realize

(a) any driving-point function

(b) any two of the four short-circuit admittance parameters of a two-port network

(c) certain sets of n short-circuit admittance parameters of an n+1-terminal network

where each of the parameters is specified as the ratio of any two polynominals in the complex frequency variable, with real coefficients. The required RC networks can always be made to take the form of grounded ladder-type structures some of which, in particular cases, reduce to 2-terminal admittances.

In addition, the synthesis of practical high selectivity active RC filters is investigated. Several procedures that are suitable for the realization of transmittance functions are discussed and compared. Among these are included positive RC – negative RC partitioning synthesis (Linvill's method), positive RC – positive RL partitioning synthesis (Horowitz's method), parallel active RC transfer function synthesis (Yanigasawa's method), and positive RC – negative RC driving-point synthesis (Kinariwala's method). The following questions are examined: How should the degrees of freedom inherent in a synthesis technique be used in order to obtain optimum networks? Which synthesis procedure is best for a particular pole-zero configuration? where "optimum" and "best" refer primarily to insensitivity of transmission characteristics to changes in component elements. Some of the answers are illustrated by using two of the synthesis techniques to realize a twelfth-order Tchebycheff equal-ripple parameter bandpass filter. The practical problems that arose in the construction of this filter are also described. It is concluded that the present state of the art is such that at frequencies where crystals are not available and magnetic elements are rather large and costly, the use of active RC filters should definitely be considered.

Microfilm $2.75; Xerox $6.20. 128 pages.

A SECONDARY EMISSION CATHODE ALGEBRAIC MULTIPLIER

(L. C. Card No. Mic 61-491)

George Curtis Sponsler, III, Ph.D.
Princeton University, 1953

A new type electron tube and associated circuitry designed for use as a multiplier unit in electronic analogue computers is described. The tube employs an electron gun which produces an electron beam of an elongated rectangular cross-section. This beam bombards a target dynode which acts as a secondary electron emission cathode. The induced secondary electron current is controlled by a retarding electrostatic field exerted by a grid or control screen. The intensity of the primary beam current is controlled by electrostatically deflecting the beam across an interception aperture of multiple triangular perforations. Voltages representing the variables to be multiplied are applied to the beam deflection plates and the screens which control the secondary electron emission. The net current leaving the target is proportional to the product of the two input voltages. This target current is measured with the aid of a feedback amplifier which generates an output voltage proportional to the target current but maintains the target potential constant with respect to the common electrical ground. Operation with all four polarity combinations is permitted by use of a dual interception aperture and a double control screen assembly. To the extent of the practical development reached, the output characteristics are found to display undesirable non-linearity.

Certain mathematical problems which arose during the development of the multiplier are considered. The profile of the electrostatic field potential in the planar region between the target and control screen is investigated, taking account of the effect of space charge and the initial secondary electron energy distribution. A formula is developed for the improvement in linearity of beam current control to be expected by use of a multiply rather than a singly perforated interception aperture. Practical examples of the use of the mathematical theories and complete results of the multiplier development tests are presented. Microfilm $2.75; Xerox $6.40. 131 pages.

ANALYSIS OF PARAMETRICALLY EXCITED CIRCUITS

(L. C. Card No. Mic 60-3710)

Tsu-Te Yang, Ph.D.
University of Pennsylvania, 1960

Supervisor: Y. H. Ku

Parametric excitation is defined as the condition of self-excitation of a dynamical (mechanical or electrical) system caused by the variation of an energy storage parameter of the system. This dissertation expounds the fundamental theory of parametrically excited electric circuits in the light of new semiconductor components, especially the reverse-biased p-n junction diodes. Simulation studies of the variable capacitance model of

parametric amplifier was made on an analog computer. The pertinent differential equations have been solved both analytically and topologically. Necessary conditions for parametric amplification and criteria of stability are developed and established.

Parametric excitation is first treated in heteroparametric systems, in which a linear system parameter is made dependent on time by some external agent. The limiting factors for parametric amplification are derived in terms of circuit constants from the phase-plane analysis. A matrix solution of the Hill-Meissner equation is developed in the stability study of the circuit. The binary property of subharmonic oscillations of the order 2 in a parametric circuit is shown analytically in the discourse.

In the treatment of autoparametric excitation which depends upon the functioning of a nonlinear energy-storage parametric in the circuit, the basic model of a nonlinear capacitance is first established. A complete analysis of the autonomous system follows, utilizing Lindstedt's approximation to arrive at a periodic solution. A closed form phase-plane solution is obtained which provides a fresh insight into the negative resistance effect and energy relations in the system. The Second Method of Lyapunov is applied to the particular type of nonlinear differential equation and a Lyapunov function has been found to satisfy the stability criterion. Experimental curves obtained with the aid of electronic analog computer are in good agreement with analytical results.

The behavior of the same representative nonlinear capacitance circuit is then studied with reference to the existence of subharmonic oscillations when a harmonic forcing function of approximately half the natural period of the circuit is applied. The threshold condition at which subharmonics can occur has been rigorously determined and discussed. By introducing transformation technique in the study, two typical stability curves are drawn illustrating the possibility of bi-stable and tri-stable states of subharmonic oscillations.

Finally, the general energy relations underlying all nonlinear elements are discussed. The well-known Manley-Rowe theorem is discussed and given physical interpretation not only to the circuit model of this paper in the production of subharmonic oscillations but also to other types of parametric circuits known to-date. The essential difference between reactive and non-reactive nonlinear elements are brought into focus by specific examples.

A bibliography of 370 entries is included.

Microfilm $3.05; Xerox $10.60. 235 pages.

GENERALIZED THEORY OF TRANSMISSION OF ELECTROMAGNETIC WAVES ALONG A DIELECTRIC COATED CONDUCTING CYLINDER

(L. C. Card No. Mic 61-2075)

Leon Wolf Zelby, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. P. P. Lombardini

The problem of a lossless guiding structure for electromagnetic waves formed by a perfectly conducting cylinder coated with a uniform layer of perfect dielectric of arbitrary thickness was solved to determine the natural modes of this structure, and also the field configuration in presence of excitation.

The characteristic mode equation, which was obtained by the self-consistent field method solution of Maxwell's equations for steady state harmonic time variations, was interpreted with respect to mode behavior. The propagation modes on this structure are surface-waves forming a discrete, doubly infinite set, with the propagation constant in the range $|k_o| < \beta < |k_1|$. Except for $n = 0$, the modes form hybrid EH_{nm} and HE_{nm} pairs, with the former having more TM - like characteristics, and the latter more TE - like characteristics. The coupling between the component fields of these pairs decreases with increasing mode order so that the very high order modes tend to lose their hybrid properties.

Only two modes, the TM_{00} and EH_{10} (sometimes referred to as the EH_{11} mode) have cutoff frequencies in the proper sense. All the other modes evince transition frequencies rather than cutoff frequencies at which transition from surface-wave propagation to radiation takes place. Evanescent modes are not supported by this structure. In the presence of infinitesimally thin coating only the TM_{00} mode can exist on this structure.

The phase velocities of all the modes lie in the range $c/\sqrt{\mu\epsilon} < v_{ph} < c$, with the structure exhibiting normal dispersion, i. e. the phase velocity decreases with increasing frequency. The field concentration in the vicinity of the structure decreases with increasing mode order; it increases, however, with increasing thickness of the dielectric layer. The dielectric and conductor losses increase with increasing frequency, but they decrease with increasing mode order. The attenuation constant is relatively independent of the mode order decreasing linearly with increasing ratio of the outer radii of the conducting core and the dielectric layer (the maximum value of this ratio is one).

The excitation problem was solved by assuming a magnetic current ring source whose axis coincided with the axis of the conducting core. The actual fields were obtained by evaluation of the inverse Fourier transform of the azimuthal magnetic field using the method of steepest descent.

In this case, in addition to the discrete set of surface-wave modes, there exists also a continuous spectrum of radiating waves for values of the propagation constant in the range $0 < |\beta| < |k_o|$, whereas for $|\beta| > |k_1|$ there are no solutions satisfying the characteristic equation. Due to the orthogonality of all modes with regard to power considerations, launching efficiencies were determined, and it was found that, theoretically, a maximum of 100% launching efficiency was possible, with indications that efficiencies in excess of 90% were quite feasible.

Microfilm $2.75; Xerox $4.60. 88 pages.

ENGINEERING, MARINE

WAVE RESISTANCE: SOLUTION OF MICHELL'S INTEGRAL FOR POLYNOMIAL SHIP FORMS.

(L. C. Card No. Mic 60-6904)

Finn Christian Michelsen, Ph.D.
University of Michigan, 1960

The purpose of this study is to obtain a solution of the Michell Integral for wave resistance of surface ships in a form suitable for computations. It is shown that at least for polynomial ship forms, a solution exists which depends upon the terms of the polynomial and ship's speed.

The results are based on Professor Birkhoff's transformation of the original integral expression of Michell. This transformation introduced two auxiliary functions, namely the Hull Function and the Michell Function. A study of these two functions is made and an infinite series expression for the Michell Function in terms of products of Bessel Functions and Confluent Hypergeometric functions is obtained. An integration of the product of the auxiliary functions over a finite area leads to a series form of solution of the wave resistance coefficient. This solution is shown to be convergent.

The task of evaluating the wave resistance from the given expressions would be prohibitively long if it were to be repeated for each individual design. The real significance of the results obtained lies in the fact that a systematic evaluation of the formula can be undertaken with the aid of digital computers, and values for the wave resistance coefficient tabulated for each term of the hull polynomial and for specified values of the Froude Number. Whenever such tables become available the calculation of the wave resistance of ships will have been reduced to a minimum of labor, involving only a few multiplications and additions. It should thus be possible to investigate families of ship forms to determine shapes of minimum wave resistance.

Because the Michell Integral forms the basis for this study, all results are subject to the limitations of the linear wave theory.

Microfilm $2.75; Xerox $3.80. 66 pages.

ENGINEERING, MECHANICAL

MEASUREMENT OF VELOCITY AND TEMPERATURE FIELDS WITH HEAT TRANSFER IN A SHORT VERTICAL TUBE

(L. C. Card No. Mic 61-1357)

Patrick O'Connor Braden, Ph.D.
The University of Texas, 1961

Supervisor: Byron E. Short

This study consisted of an experimental determination of velocity and temperature fields and heat-transfer coefficients for oil flowing in a vertical, heated, circular tube. The average velocity of the oil was varied over a small range of low values so that the flow was mixed, free and forced, laminar convection. Runs were made both with upflow and with downflow for conditions of constant wall temperature and constant heat flux per unit of wall area. The oil was a petroleum product with viscosity approximately equivalent to that of number 30 S.A.E. oil.

The test section had a length to diameter ratio of twenty-nine for the section upstream from the instrument station. The flow conditions were such that the velocity profile was essentially fully established at the entrance of the test section. The temperature profile was developing throughout the tube so that the results were representative of the thermal entrance region of a tube.

A feature of the study was the development of the instrument used for the determination of the velocity and temperature profiles of the fluid stream. The instrument consisted of a thermocouple probe mounted in such a way that the test section could be traversed along a diameter and at the same time the viscous drag of the oil flowing past that part of the probe which was parallel to the stream could be measured. At the low velocities involved in this study the drag force on the probe at a point in the stream was approximately a linear function of the velocity and the viscosity.

Since no analytical or other experimental determinations of velocity and temperature fields of real fluids for the conditions of this study are known, the results were correlated with the limited number of analytical investigations which have been made for idealized fluids, and they agree with these at least as regards trends. Heat-transfer coefficients were calculated by numerical integration of the velocity and temperature profiles and agree well with existing experimental and theoretical results.

Microfilm $2.75; Xerox $7.00. 146 pages.

THE DYNAMICS OF THE INFINITELY-LONG, SELF-ACTING, GAS-LUBRICATED JOURNAL BEARING UNDER A STEADY LOAD.

(L. C. Card No. Mic 61-2021)

Herbert Su Yuen Cheng, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. P. R. Trumpler

The governing equations for the dynamical system of a self-acting gas-lubricated journal bearing are formulated. An approximate solution for the equilibrium position of the journal center is obtained by use of Galerkin's method. The equilibrium solution shows close agreement with the exact numerical computer solution obtained by Elrod. The stability of the equilibrium solution is investigated by solving the linearized equations on an analog computer. The solution of the set of linearized equations shows that there exists a threshold speed of instability for each equilibrium position. The value of this threshold speed is presented in a stability chart. In addition, approximate particular solutions for the non-linear dynamical equations are obtained by use of the analog computer. The results are shown as trajectories of the journal center when it is displaced arbitrarily from the equilibrium position.

Microfilm $2.75; Xerox $7.80. 167 pages.

A STUDY OF THE EFFECT OF CHEMICAL NON-EQUILIBRIUM IN THE FLOW OF A HIGH TEMPERATURE REACTIVE GAS MIXTURE THROUGH A CONVERGING-DIVERGING NOZZLE

(L. C. Card No. Mic 61-1947)

Clarence Quentin Ford, Ph.D.
Michigan State University, 1959

Major Professor: Joachim Lay

The object of this thesis was to investigate the recombination reactions of a dissociated high temperature gas mixture, as the mixture expands in a converging-diverging nozzle, and what effects these reactions might have on the expansion process.

As an approach to the problem, an analytical development was carried out, on the basis of collisional properties, to establish relationships which would describe the fluid dynamics and chemical kinetics. These relationships were combined to permit an analysis of the flow of a compressible mixture undergoing recombination reactions. The generalized analysis was then reduced to a simplified form, that would show only the effects of reactions occurring at a finite rate.

A particular nozzle shape was established, along with a set of initial conditions for a chemically reactive gas mixture, and a set of calculations were carried out to obtain physical properties along the nozzle axis. As a means of comparison, flow processes with recombination reaction rates of zero and infinity were calculated from the same initial conditions and for the same nozzle configuration. A zero reaction rate is equivalent to the "frozen" flow, while an infinite reaction rate is comparable to a process always in an equilibrium state.

Comparison of the finite reaction rate flow path calculations with those for the frozen and equilibrium paths shows that, at the high temperatures resulting from a combustion process, the finite path remained close to the equilibrium path for the entire nozzle length. As the temperature decreased and velocity increased with expansion, the finite path diverged slowly from the equilibrium path. However, contrary to some published results on similar studies, performed on individual gases rather than a mixture, the flow path did not assume a frozen path in the diverging section of the nozzle.

Lack of experimental data on chemical reaction kinetics, especially in the high temperature regime, prevented a more thorough analysis of nozzle flow for a chemically reactive fluid. However, it was indicated in the results of this study that an equilibrium flow path, for which tabulated data are available, would approximate actual conditions more closely than the commonly employed frozen flow path. Microfilm $2.75; Xerox $5.60. 111 pages.

ENGINEERING MECHANICS

THE BEHAVIOR IN TENSION, TORSION, AND FLEXURE OF MEMBERS MADE OF BRITTLE MATERIALS.

(L. C. Card No. Mic 61-1595)

James Warren Baldwin, Jr., Ph.D.
University of Illinois, 1961

Demands for high temperature resistance in many applications of the modern space age are dictating the use of members made of brittle materials, and the use of these members in structures where weight is of paramount importance demands an accurate analysis for predicting their behavior. Not only the ultimate load carrying capacity but also the load-deformation characteristics of these members are needed for a satisfactory design. Numerous tests have been made to determine the ultimate strengths of specific members, but little has been done to develop a method for predicting the complete behavior of a given member from the material properties obtained in a simple standard test.

In this investigation the implications of two hypotheses, the non-linear stress-strain hypothesis and the Griffith crack theory, were discussed and methods were developed for comparing experimental data on the basis of these hypotheses. Both digital computer programs and electronic analog computer circuits were designed for the solution of the equations involved in these comparisons. Brittle materials were considered to be arranged in a brittleness spectrum with materials exhibiting small amounts of plastic action at the lower end and materials exhibiting no plastic action at the upper end. Materials from near each end of the spectrum were selected for investigation. Experimental apparatus was designed and built for testing of specimens under combined axial tension and flexure. Eighteen epoxy resin specimens and 88 plaster specimens were tested in this apparatus.

Data from the epoxy specimens and from 106 cast iron specimens was analyzed in accordance with the non-linear stress-strain hypothesis. The cast iron data was taken from the literature and consisted of data from tension, torsion, and flexural tests. Only a few of the tests of epoxy resin were considered successful, but these tests indicated that any further investigation of extremely brittle materials should be based on the Griffith crack theory. The tests and analysis of the plaster specimens were based on the Griffith crack theory and involved introducing artificial flaws into the specimens.

It was concluded from this investigation that the behavior of members made of materials from the lower end of the brittleness spectrum may be satisfactorily predicted on the basis of the non-linear stress-strain hypothesis, while the behavior of members made of materials from the upper end of the spectrum must be predicted on the basis of the Griffith crack theory. In addition, it was concluded that a great deal more work will be necessary before the behavior of members made of materials which fall in the intermediate region of the brittleness spectrum may be satisfactorily predicted.

Microfilm $2.75; Xerox $6.40. 133 pages.

THE BEHAVIOR OF BEAM-COLUMNS IN THE INELASTIC RANGE

(L. C. Card No. Mic 61-1651)

Bichara Bichara Muvdi, Ph.D.
University of Illinois, 1961

Two theories are presented for the analysis of beam-columns in the inelastic range. A numerical procedure as outlined in Appendix A, would lead to results as accurate as desired. However, this method entails rather lengthy and sometimes prohibitive computational work. For this reason, a relatively simple, though approximate, method is proposed for the prediction of moment-load or load-deflection curves, as well as the collapse load for beam-columns which are subjected to constant transverse loads. This approximate method requires a trial-and-error solution of two independent relations between the variables axial load, moment and curvature. The first of the two axial load-moment-curvature relations is established from considerations of the equilibrium of internal forces and moments, and is represented graphically by dimensionless interaction curves along with a moment-curvature equation. The second axial load-moment-curvature relation is developed by equating the internal and external moments, and by considering the deflection characteristics of the member. A sample problem is solved to illustrate the proposed method of solution.

Tests were performed on beam columns made of three different materials, namely 2024-T4 aluminum alloy, SAE 1020 steel and 17-7PH stainless steel. Several parameters were examined and they included shape of cross-section, slenderness ratio, position and magnitude of the transverse load and eccentricity of the axial load. Dimensionless moment-load curves were constructed from the test data and compared to those obtained analytically. Very good agreement was observed in all instances, as the discrepancy between the predicted and actual values of collapse loads was generally less than about 7 per cent.

In general, an appreciable increase was observed in the load-carrying capacity beyond that corresponding to initiation of yielding. This increase in load-carrying capacity was found to vary directly with the magnitude of the transverse load, and inversely with the slenderness ratio and the strain at yielding. Furthermore, members with end eccentricities of 15 per cent of the section depth attained a much higher increase in the load-carrying capacity than members with zero end eccentricities.

Microfilm $2.75; Xerox $3.80. 68 pages.

ENGINEERING, METALLURGY

SOME ELASTICITY PROBLEMS FOR AN ANISOTROPIC SOLID

(L. C. Card No. Mic 61-1516)

Robert Young Bodine, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Gerald Pickett

The material is assumed to have a strain energy function of the form that admits 13 elastic constants. The structures considered are laminated, the elastic constants being the same for each layer except for the cross shear terms which alternate in sign from layer to layer. This restriction is not inherent in the analyses, however.

The stresses and displacements in a thick walled cylinder under uniform external, or internal, pressure are determined in closed form by applying the principles of three dimensional elasticity. Cases with and without axial restraint are considered.

A hollow cylinder experiencing flexure with constant transverse shear is treated in a similar manner, the stresses and displacements being obtained in closed form.

The stiffness and stress distribution are determined for a laminated prismatic bar by an energy procedure.

Numerical examples are included for each problem.

Microfilm $2.75; Xerox $3.60. 62 pages.

NUCLEATION CATALYSIS AND GROWTH IN SUPERCOOLED LIQUID TIN

(L. C. Card No. Mic 61-1684)

Martin Eden Glicksman, Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: Wylie J. Childs

A unified experimental approach was used to investigate three problems relating to nucleation and growth in supercooled tin.

1. Nucleation catalysis was investigated by measuring the characteristic supercooling of bulk-liquid tin when in contact with various gross catalytic substrates. Where definite catalysis by a substrate occurred, reproducible supercooling was obtained. Since changes in crystallographic orientation produced changes in characteristic supercooling for an yttrium substrate, support is lent to the crystallographic-misfit hypothesis.

2. Growth-velocity in supercooled tin was studied by using a thermoelectric-velocity transducer to measure the velocity of dendritic growth in bulk-liquid tin supercooled as much as 30C°. An empirical growth-velocity law was derived from these data.

3. The development of grain size was investigated by methods outlined by J. Walker (Masters thesis, Rensselaer Polytechnic Institute, May 1959). Based on observations obtained, and equations derived, in the course of this investigation, a hypothesis has been suggested to account for these results.

Microfilm $2.75; Xerox $4.20. 80 pages.

EFFECTS OF SOME LIQUID METAL ENVIRONMENTS ON THE FRACTURE OF COPPER

(L. C. Card No. Mic 61-1756)

Dwight Alan Kraai, Ph.D.
University of Michigan, 1961

The variation of fracture strength of solid copper wire was investigated as a function of the interfacial free energy between the specimen and its liquid metal environment.

Numerous reports in the literature indicate that non-corrosive environments can have a significant effect on the tensile fracture strength of materials. The general effect of liquid metals is to reduce both strength and ductility. The more deleterious environments sharply reduce the level of normal fracture stress. The literature further indicates that changes in fracture strength due to changing environmental conditions might be explained on the basis of interfacial free energies. That interfacial energies are associated with fracture seems logical not only because free surfaces are formed, but also because the environments are non-corrosive, they do not form compounds with the solid metals, and their mutual solubilities are essentially zero in many cases. Such an effect must then act at the surface. A measure of such surface effects would be the interfacial energy, a physical property, between the solid metal and its environment.

From considerations of the energy required to propagate a crack in a brittle material previous investigators have shown that the fracture stress can be approximately represented by the following equation:

$$\sigma_f = K\left(\frac{E\gamma}{d}\right)^{\frac{1}{2}} .$$

Where σ_f is the fracture stress, E is Youngs modulus, d is the grain size, γ is the total surface free energy expended in exposing unit area of the crack faces and K is a dimensionless coefficient of the order of 5.

The experimental part of this work dealt with establishing; 1) the existence of an effect of environment on fracture strength; 2) the relative magnitude of the effect; 3) the approximate validity of the expression given above.

These aims were realized by fracturing copper wires partially wet by external liquid lead-bismuth environments systematically varied in composition. Changing the composition of the environment varied the interfacial free energy. It was found that the tensile fracture stress of a copper wire was reduced by the successive addition of bismuth to a lead-bismuth environment. At 650°F for instance, an environment of liquid lead gave little reduction in strength while an environment of liquid bismuth reduced the fracture strength to 7,200 psi from 45,000 psi for liquid lead. Copper failed in an intergranular brittle manner when fractured in bismuth with no significant reduction in area. Copper failed in lead after considerable elongation and showed approximately 60% reduction in area. The change in fracture stress with changing interfacial energy corresponded to that predicted by the above expression for the higher bismuth region of lead-bismuth environments. The value of K obtained in the investigation is about 15 or 3 times the value theoretically indicated.

It was found that reliable and reproducible values for the fracture strength of a solid metal in a liquid metal environment depend on the following: 1) obtaining intimate contact between the solid and liquid metals; 2) having a supply of liquid metal present for the continued propagation of a failure crack.

The strength of copper in lead-bismuth environments is not affected by the length of time of immersion of the copper in a stress free condition prior to fracture at the temperature and times of immersion used in this investigation.

Small additions of zinc, cadmium, thallium, and antimony were added to bismuth in place of lead to determine the effect that they have on the fracture strength of copper. The effect was beneficial relative to 100% bismuth in all cases with antimony being the most effective.

Microfilm $2.75; Xerox $5.60. 113 pages.

THE EFFECT OF TORSIONAL DEFORMATION ON SELF-DIFFUSION IN SILVER

(L. C. Card No. Mic 61-2048)

Chung Hsia Lee, Ph.D.
University of Pennsylvania, 1961

Supervisor: R. Maddin

The enhancement of self-diffusion in silver by torsional deformation has been studied extensively. Specimens were prepared from 99.99 per cent pure silver single crystals which were grown by Bridgeman method under a vacuum of about 5 micron. The diffusion coefficient was measured by a standard sectioning method employed with tracer techniques. After checking the reliability of the equipment by measuring the unstrained diffusion coefficient at the diffusion annealing temperatures, 600, 700, 750, and 800°C, the enhanced diffusion experiments were performed under various deformation conditions. They may be grouped as follows:

In the first group all the specimens were twisted, to a total surface strain of 0.91, during the diffusion anneal at temperatures of 700, 750 and 800°C. A single strain rate was employed. Diffusion coefficients were measured as a function of strain rate which varied from zero to 24×10^{-5} per second. The magnitude of the enhancement of diffusivity attained values of nearly 100 for some of the strain rates and temperatures used. The enhancement of diffusion by strain rate is inversely proportional to the temperature at which diffusion occurs. The activation energy for diffusion at the maximum strain rate used is reduced to one half of its magnitude.

In the second group different surface strain, 0.1, 0.35 and 0.50 were used. The enhancement of diffusion by plastic deformation was found to be independent of total surface strains.

In the third part of this investigation, constant stress was used as variable to study the enhancement of diffusion. The enhancement was found to vary exponentially with stress. A thermodynamic analysis showed that the effect of stress should be very small under the present experimental condition. Therefore, the enhancement found in this phase of the investigation at some of the high stress levels are due to the associated strain rate.

Finally, this investigation was extended to measure the life time of point defects. Under the present experimental conditions, the life time was found about 100 seconds. A semi-quantitative explanation of the results if presented. All results of this investigation were found to be self-consistent. Microfilm $2.85; Xerox $9.90. 220 pages.

THE ROLE OF CARBON IN TEMPER BRITTLENESS

(L. C. Card No. Mic 61-1559)

James Junior Wert, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Philip C. Rosenthal

Temper brittleness is a phenomenon which can occur in low alloy steels if they are slow cooled through or reheated in the temperature range of 575° F to 1100° F. The phenomenon manifests itself as a marked lowering of notched bar impact properties when compared with steels which have been quenched through the embrittling temperature range.

Although enough information has been obtained so that temper brittleness can now be eliminated or prevented by suitable heat treatment or by the addition of certain alloying elements, the exact cause of temper brittleness still remains an unsolved mystery.

Of the many theories of temper brittleness which have been proposed, most accept the thesis that carbon is necessary for temper embrittlement to occur. Since previous investigators have reported a correlation between the magnitude of the relaxation peak due to the stress-induced diffusion of carbon as measured by an internal friction test and temper embrittlement, the object of this investigation was to follow the changes in the internal friction characteristics and impact properties of a nominal AISI 3310 steel containing varying amounts of carbon.

AISI 3310 steel specimens were decarburized for varying periods of time, utilizing a moist hydrogen technique. All specimens were austenitized at 1700° F for one hour and water quenched. They were then tempered one hour at 1250° F and water quenched. After this treatment, the specimens were in the tough condition. One-half of the tough specimens were given an additional fifty-hour embrittling treatment at 930° F and then water quenched. Internal friction spectrums of specimens of each carbon content, in both the tough and the embrittled conditions, were determined between 30° F and 475° F by means of a torsional pendulum. Specimens with identical treatments were impact-tested in the temperature range of -190° C to 150° C.

Internal friction measurements of a tough steel, which had not been decarburized, exhibited a pronounced relaxation peak near room temperature due to stress-induced diffusion of carbon and another smaller peak at 440° F. Both of these peaks were absent in specimens which had received an embrittling treatment at 930° F. Internal friction measurements of embrittled specimens previously decarburized to 0.046 per cent carbon exhibited a carbon peak whose magnitude depended on the grain size of the specimen. Specimens decarburized to 0.006 per cent carbon did not exhibit any relaxation peak near room temperature or 440° F in either the tough or embrittled condition. However, impact tests indicated a shift in the transition temperature of at least 45° C after embrittlement.

Specimens which had been decarburized to 0.006 per cent C were recarburized to 0.205 per cent C. The two relaxation peaks reappeared again and impact properties returned to about their normal values.

From the results of this investigation it is apparent that reducing the carbon content of an AISI 3310 steel to 0.006 per cent C does not remove susceptibility to temper embrittlement but, instead, causes the transition from ductile to cleavage fracture of tough specimens to appear at a higher temperature. The transition temperature of embrittled AISI 3310 steel appears to be relatively insensitive to carbon content while the transition temperature of tough specimens is raised as carbon is removed. Temper brittleness was also found to be independent of the amount of carbon held in solution, but, in general, embrittled specimens have less carbon in solution due to the lower tempering temperature. The disappearance of the carbon peak during embrittlement was found to be a function of grain size and carbon content and not the degree of embrittlement. The damping peak which appears at 440° F was attributed to interaction of dislocations and interstitials and is similar in nature to the Köster damping observed in cold worked Fe-C alloys.

On the basis of data obtained in this investigation and an extensive literature survey, it is proposed that temper brittleness results from segregation of interstitial atoms to preferred sites formed by substitutional solute elements segregated at prior austenite and ferrite grain boundaries. Since dislocation locking is stronger in the embrittled state than in the tough state, brittle fracture of embrittled steels follows the weakened grain boundaries. Segregation is less pronounced in the tough state due to higher tempering temperatures and some dislocations are relatively free to move; hence, brittle fracture occurs by cleavage across the grains.

Microfilm $2.75; Xerox $5.40. 108 pages.

ENGINEERING, MINING

OIL AND GAS RECOVERY AND RESERVOIR PERFORMANCE IN RELATION TO PERMEABILITY VARIATION

(L. C. Card No. Mic 61-1375)

Richard Dutton Seba, Ph.D.
The University of Texas, 1961

Supervisor: Dr. H. H. Power

The effect of partial completion in stratified reservoirs was investigated, using a resistance network model. Linear steady-state flow was determined for two and three layered systems of different thicknesses and permeability values.

The primary objective of this research was to determine

the completion zone within the well bore that would insure optimum sweep efficiency, ultimate recovery, and other desired benefits.

The secondary objective of this investigation was to determine those characteristics of a stratified reservoir that are associated with optimum penetration and completion.

The stratified reservoir performance was simulated by means of a two-dimensional electrical resistance network model. The values assigned to the network resistors were proportional to the permeability of the prototype reservoir and were arranged in layers to conform to the layers of the stratified reservoir. The resistors of each layer were interconnected at all interior boundary points, thus simulating crossflow between layers of different permeability in the prototype reservoir. The resistors of each of the layers of the model were changed to simulate different permeabilities of the stratified reservoir. The thicknesses of the layers of resistors in the model were altered to simulate different thicknesses in the prototype reservoir. The variation of the zone of completion was simulated by changing the position and length of the constant potential surface which simulated the well bore of the producing well.

From the data obtained with this model, iso-potential and flow lines were constructed to permit analysis of the production characteristics of the stratified reservoir under the conditions imposed. From this graphical analysis, sweep efficiencies of the prototype reservoir were determined as a function of time. Correlations of the sweep efficiency with several other measurable quantities gave a better understanding of the factors at work in a stratified reservoir under various conditions. The total resistance of the model was also determined under the conditions imposed, permitting the determination of the productivity index of the prototype reservoir. The productivity index was also correlated with other measurable quantities, providing more information on the factors active in the stratified reservoir.

As a result of this investigation, it is demonstrated that the production characteristics for a stratified reservoir are a function of the thickness ratio and the permeability ratio of the layers, as well as the position and the length of the zone or zones of completion. Optimum location and length of the zone or zones of completion, as well as the most favorable reservoir conditions for their application, were determined. A discussion of the economics associated with partial well penetration permits a more complete analysis and justification for the method presented.

The need for future extensions of this work are indicated. The model and associated mathematics for the investigation of partial penetration in a radial steady-state system and in linear and radial transient systems are presented. Investigation of these systems are presented. Investigation of these systems would provide an additional contribution to the knowledge of the producing characteristics of stratified reservoirs.

Microfilm $2.75; Xerox $9.00. 196 pages.

ENGINEERING, NUCLEAR

A STUDY OF THE FREE RADICAL YIELD PRODUCED IN 1-BROMOBUTANE BY IRRADIATION WITH MONOCHROMATIC X-RAYS OF DIFFERING PHOTON ENERGIES

(L. C. Card No. Mic 61-1731)

William Roy Clendinning, Ph.D.
University of Michigan, 1961

Previous studies by Garsou[1] and Emmons[2] have indicated that the yield of radiation effects produced in certain compounds by irradiation with x-rays was a function of the photon energy of the radiation.

The purpose of the present study was to determine the number of free radical species produced per unit of energy absorbed in liquid 1-bromobutane by irradiation with monochromatic x-rays of different photon energies. Sixteen different photon energies in the region of the bromine K edge absorption energy were used in this study.

Monochromatic x-radiation was obtained by irradiating particular elements with the full beam x-ray output of a standard Machlett AEG-50T x-ray tube in order to obtain the characteristic fluorescence radiation of the specific element used. K_α radiation was obtained selectively by attenuating the K_β radiation by means of filters.

A technique for making thin filters from powdered compounds (used whenever metallic foils are unavailable) was developed. A special calorimeter was developed to measure the energy content of low energy x-ray beams. Monochromatic x-ray beams with less than 5 per cent contamination from all sources were obtained with intensities of the order of 2×10^4 ergs/min. The Fricke dosimeter, Victoreen low energy x-ray R-meter Model 625 and the General Electric SPG-1 beryllium window, argon-filled proportional counter were calibrated against the calorimeter at 33 different photon energies between 4 and 35 Kev. Better than 20 per cent agreement was obtained among the four measurements at all energies within the energy range of most interest (9-25 Kev).

Irradiations were made of 1-bromobutane solutions with the addition of approximately 1×10^{-7} moles per cc of DPPH in order to scavenge the radicals produced in the radiation-induced decomposition of 1-bromobutane. Preliminary studies indicated that this concentration of DPPH was sufficient to scavenge completely (effectively) all radicals produced at the x-ray intensities used in the study. The radiation yield was measured as the change in DPPH concentration produced per unit of energy absorbed in the sample.

No significant differences were noted in the radical pair yield for any of the photon energies used in the study. These results are in contrast with the results of Garsou and Emmons.

The G_R value (number of radical pairs produced per 100 ev of energy absorbed) obtained in this study was 2.8. No G values for 1-bromobutane irradiated with x-rays could be found in the literature for comparison. The value of 2.8 is comparable to the G value of 3.6 for the decomposition of 1-bromobutane by cobalt radiation obtained by Wilcox.[3] As a result of a constant G value, the quantum yield varies in direct proportion to the photon energy.

1. Garsou, J., Ph.D. dissertation; Liege, Belgium, 1959.
2. Emmons, A., Ph.D. dissertation; University of Michigan, 1960.
3. Wilcox, W. S., Rad. Res. 10, (1959) 112-117.

Microfilm $2.80; Xerox $9.70. 213 pages.

ENGINEERING, SANITARY AND MUNICIPAL

RADIOACTIVITY IN SURFACE WATERS— A STATISTICAL APPROACH TO ESTABLISHING BASE LEVELS.

(L. C. Card No. Mic 61-1362)

Walter Ronald Drynan, Ph.D.
The University of Texas, 1961

Supervisor: Dr. Earnest F. Gloyna

This dissertation is concerned with the collection of surface-water samples, analysis of these samples for radioactivity, and establishment of base-level values. Statistical analysis of the data produced correlations which relate the natural and man-made radioactivity content of a stream with normally used stream parameters. These newly applied correlation techniques now permit the proper evaluation and interpretation of radioactivity levels in the surface waters of Texas.

Eighteen major drainage areas in Texas were studied over a period of two years, and base-level values for radioactivity were established. The results show the contributions of radioactivity from such sources as natural mineral deposits and atmospheric fallout. Analytical comparisons show the effects of rainfall, basin topography, and other factors on the base-level values. Details of sample-collection programs, analytical techniques, radiation detection equipment, statistical methods, and original data for each sample processed are included as appendices.

A digital computer program was developed to test the data for any correlation between the suspended and dissolved radioactivity concentrations and their respective solids concentrations and streamflow. The variables were fitted to four types of linear equations, and the resulting correlations were used as a part of the base-level values presented for each station, river, and basin.

The findings of this study provide a basis for delineating additional work in the area of water-borne radioactive contamination and for guiding the interpretation of future changes in the concentrations of water-borne radioactivity. The methodology developed in this research is fully described in order that future investigators may have at hand the procedures with which advances in sample analysis may be utilized to achieve results of similar validity. Microfilm $3.50; Xerox $12.40. 271 pages.

WATER POLLUTION CONTROL IN NEW ZEALAND: AN ASPECT OF ENVIRONMENTAL CONSERVATION.

(L. C. Card No. Mic 61-1749)

Allan Hirsch, Ph.D.
University of Michigan, 1961

The dissertation presents a case study of water pollution and water pollution control in New Zealand. The objective of the study is to appraise New Zealand's experience with water pollution control as a part of the problem of using and conserving the water resource base of that nation. The study emphasizes the interrelationships of the legislative, administrative, and technological aspects of pollution control. It seeks to delineate the major social issues involved, to identify obstacles being encountered, and to indicate possible improvements in the pollution abatement program.

The control of water quality is just one aspect of the over-all problem of water resource management, and a general discussion of New Zealand water management activities is given. The current pollution control program began in 1953, with enactment of the Waters Pollution Act, which authorized a national program of pollution-abatement. A Pollution Advisory Council was established to formulate policies for this program and to coordinate the work of various government agencies with existing statutory responsibilities for pollution control. A historical perspective of earlier pollution control activities in New Zealand provides background to the current situation.

The major categories of wastes are discussed, with emphasis on delineating the special problems that each presents for pollution control. The standard of sewage treatment has been low, but improved facilities are now being constructed in many communities. The major sources of industrial pollution are the livestock industries, principally dairy factories and meat freezing works. These industries contribute a much greater polluting load than that from the total sewered human population. Forestry, mining, and various secondary industries are other sources of industrial pollution; pulp and paper mills are the most troublesome of these. Industrial waste treatment is not well advanced, but the potential polluting load is substantially reduced by economic by-product recovery. The lack of treatment of both domestic and industrial wastes is somewhat offset by the large amount of assimilative capacity available in the receiving waters.

Cases of water pollution occurring in various regions throughout New Zealand are studied to enable assessment of the scope and significance of the over-all problem. The deleterious effects of pollution are mitigated by the sparse total population, the location of most of the concentrations of population and industry near the extensive coastline, and the abundant water resources. Withdrawal uses of water appear to have been less affected generally than have other uses, because alternative supplies of unpolluted water are often available. Much of the adverse effect of pollution has involved general environmental deterioration, with creation of nuisance conditions and reduction of recreational and aesthetic amenities. The problem is described as being one which affects not only water resources, but the general quality of the environment as well.

Three major policy issues are delineated for analysis: (1) The water quality standards of the Pollution Advisory

Council were appraised. Further clarification of the existing standards would enable them to express the Council's objectives more effectively. (2) The Pollution Advisory Council has approached abatement on a solely voluntary, cooperative basis thus far, but a need for a regulatory program has become apparent. The limitations of the voluntary approach to pollution abatement are identified, and discussed in terms of welfare economics theory. (3) The effectiveness of the Pollution Advisory Council as an organization for pollution control is assessed, and possible modifications are suggested.

Probable future problems for pollution control include population growth and increased industrial output; diversification of industry, creating new sources of pollution; chronic urban fringe problems; and an emerging need for closer coordination between pollution control and other water management programs.

Microfilm $5.35; Xerox $18.90. 418 pages.

FINE ARTS

THE MARGINAL DRAWINGS OF THE BURY ST. EDMUNDS PSALTER (ROME, VATICAN LIBRARY MS REG. LAT. 12) [with] FIGURES.

(L. C. Card No. Mic 60-4998)

Robert Mark Harris, Ph.D.
Princeton University, 1960

This dissertation is concerned with a two-fold problem with respect to the marginal drawings in the Bury St. Edmunds Psalter (Rome, Vatican Library MS Reg. lat. 12). First and more general, an attempt will be made to see these illustrations within the perspective of the broad problem of the so-called "literal" illustration of the psalter in Western medieval art (with some consideration for the parallel attempts in Byzantine psalter manuscripts). Second, and more specific, the aim will be to define with some precision the position of this body of imagery within Anglo-Saxon art and to study its particular physiognomy within eleventh century English culture in general.

Chapter I attempts to establish the general complexion of the psalter text in pre-Conquest England together with the issues raised by its illustration. As an insight into these questions, fundamental to the nature of the Bury St. Edmunds Psalter, I have selected for study an approximately contemporary Anglo-Saxon psalter manuscript now in Paris (Bibliothèque Nationale, fonds latins 8824). Unlike the Bury psalter, the Paris manuscript has already been extensively discussed in the literature with regard to its highly interesting bilingual texts. The illustrations of this text, in contrast to the Bury manuscript, are of smaller number and more obviously linked to the tradition of "literal" psalter imagery. Chapter II is a study of the "literal" illustrations in the Vatican psalter which can with some certainty be related to an earlier psalter model, partially reflected in Boulogne, Bibliothèque Municipale MS 20. By this means we are able to determine both the degree of invention and tradition within one section of the psalter drawings, and to suggest more precisely the stimuli which affected these forms. Chapter III is a consideration of the New Testament imagery while Chapter IV concerns itself with the Old Testament references within the illustrations. By focussing our attention in these sections on those drawings which can readily be compared with related imagery or themes we are enabled to define more completely the quality and degree of imagination and originality within these illustrations.

Our results indicate that these marginal drawings belong in part to the tradition most completely represented by the ninth century Carolingian psalter in Utrecht (University Library MS 484). But just as these illustrations have been transposed from a position prefacing each psalm to one marginal to the text, similarly their content has been modified by the incorporation of new models, texts and interests. These modifying elements include the adoption and adjustment of illustrations through liturgical usage, references to a world of royal, ceremonious forms, and the impact of motifs derived from vernacular literature. Their common character resides in a preoccupation with the particular, the tangible and concrete, and is intimately united with the continuation in eleventh century England of a "literal" concern with the imagery of the psalter text. There is revealed within this body of drawings a desire to animate, reconstruct and singularize the older, more traditional themes.

A number of contacts with the imagery on the later folios of London, British Museum Harley MS 603, a Canterbury book, indicates that the Vatican psalter was not created at the monastery of Bury St. Edmunds in Suffolk, but is to be seen as part of the same scriptorium which produced the Harley manuscript. From these contacts it emerges as well that the Vatican psalter may be dated ca. 1050; later than has recently been suggested. Seen in the light of the development of the Canterbury scriptorium the Bury St. Edmunds Psalter witnesses the richness, diversity and complexity of English art in the years preceding the Norman conquest.

Microfilm $7.80; Xerox $27.70. 613 pages.

INVESTIGATION OF THE PHYSICAL STATE OF THE MILK PROTEINS IN UNDILUTED SKIM MILK

(L. C. Card No. Mic 61-138)

Poul Martin Trost Hansen, Ph.D.
University of Illinois, 1960

Electrophoretic patterns have been obtained of raw, undiluted skim milk and ultracentrifuge whey by the use of native, protein-free milk system as the buffer phase. This system was obtained by dialysis of 208 ml 5% lactose against 100 liters of skim milk for 48 hours at 1-2° C.

The studies showed that micellar casein in its native environment moves as a homogeneous peak with no indication of the split into α-, β-, and γ-casein observed in patterns obtained in veronal buffer. It was found that pasteurization under laboratory conditions of 143° F for 30 minutes produced an increase in the mobility of all three resolved peaks in the skim milk pattern while the relative areas were not appreciably changed. On the other hand, storage studies indicated that the patterns of raw skim milk did not change even after 192 hours at 2° C.

In the patterns obtained with ultracentrifuge whey, five electrophoretic components were observed and identified as immune globulins, β-casein, α-lactalbumin, β-lactoglobulin, and "blood" serum albumin. In addition to β-casein, two other proteins were precipitated at pH 4.6, probably γ-casein and serum protein component 5. Since these proteins were not removed from the whey by ultracentrifugation at 55000 x g for 10 hours and at 1-2° C they must be in a non-micellar form, which was found to be influenced by temperature. There was no indication of any association amongst the other major milk serum protein components in native, protein-free milk system.

To aid in the analyses of the electrophoretic patterns, a method was developed for the dissection of symmetric or asymmetric Gaussian curves by means of the University of Illinois Digital Computer, the Illiac. The program was constructed to accept the data in the form of the coordinates of the pattern and a set of pre-supposed parameters. By iteration a reduced sum of squares fit is then computed and the constants of the individual Gaussian functions are calculated. The following mathematical relationships were employed:

$$\hat{SS} = SS_o + \Sigma y_{ij}(2Y_{ai} - 2Y_{ci} + y_{ij}) - \frac{\left[\sum_i (Y_{ai} - Y_{ci} + y_{ij})Z'_{ij}\right]^2}{\Sigma (Z'_{ij})^2}$$

$$\hat{y}_{uj} = \frac{\sum_i (Y_{ai} - Y_{ci} + y_{ij})Z'_{ij}}{\Sigma (Z'_{ij})^2}$$

where: $\hat{SS}$ = the reduced sum of squares

SS_o = the original sum of squares

Y_{ai} = the observed ordinates of the pattern

Y_{ci} = the calculated ordinates of the pattern

y_{ij} = the calculated ordinates of the jth component

Z'_{ij} = the calculated exponential part in the Gaussian function after a change in any one or all of the parameters: the mean of the function, or the right or left hand standard deviation

$\hat{y}_{uj}$ = the best fitting maximum ordinate of the jth component.

Microfilm $2.75; Xerox $6.40. 133 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

A GEOGRAPHICAL ANALYSIS OF THE PRODUCTION AND MARKETING OF FRESH FRUITS AND VEGETABLES IN FLORIDA, GEORGIA, AND SOUTH CAROLINA.

(L. C. Card No. Mic 61-1480)

Sidney Roberts Jumper, Ph.D.
The University of Tennessee, 1960

Major Professor: Loyal Durand, Jr.

A recent development in the field of geography has been an interest in the marketing of agricultural products. Past geographic studies were concerned primarily with producing areas and seldom examined the interrelationships between production, marketing and consumption.

The principal purpose of this study, therefore, is to examine the marketing of fresh fruits and vegetables that are produced in Florida, Georgia, and South Carolina. Regions of concentrated production exist in all three states, although Florida is the leading producer.

Most of the developments which made growth of this nation's fruit and vegetable industry possible occurred between 1825 and 1925. During this period the United States changed from an agrarian, self-sufficient economy to one that is highly urbanized, specialized, mechanized, and mobilized.

Facilities for handling fruits and vegetables have advanced accordingly. Terminal, concentration, farmers' retail, farm womens', and roadside markets have been developed to channel products from producer to consumer.

Florida ranks second to California as a producer of vegetables and first in production of citrus fruits, except lemons. Most of the Florida vegetable crop is sold fresh, although citrus is chiefly processed.

Palm Beach County is the leading producer of most Florida vegetables and New York the major consuming state. Distribution is heaviest to states along the Atlantic Coast, the Middle West occupies a secondary role, and only a small percentage moves west of the 100th meridian. For most individual vegetables the market areas are strikingly different, however. Some move primarily to the Northeast, others to the South, and others to the Middle West.

Florida citrus crops consist primarily of oranges, grapefruit, and tangerines and are produced chiefly in the central part of the state. The market area for citrus is similar to that of most vegetables, although grapefruit are distributed more widely than oranges.

The fruit and vegetable industries of Georgia and South Carolina have expanded steadily, but cannot approach Florida in volume and value. Most vegetables are produced on the Coastal Plain, whereas peaches are grown primarily in the Piedmont. Vegetable harvests occur mostly in the spring and early summer, between the Florida season and harvests further north.

A much larger portion of the Georgia and South Carolina fruit and vegetable production is consumed within the producing states than is prevalent in Florida. The pattern of South Carolina out-of-state shipments is similar to that of Florida, with most of the distribution being to states east of the Appalachians. Georgia distributes a larger portion to the Middle West.

The Columbia and Atlanta terminal markets are of special significance in marketing products grown in the two states. Both have excellent facilities and operate the year-round. Produce is distributed to most of the eastern United States, although Atlanta ships a larger quantity to the Middle West.

The future of the fruit and vegetable industries in Florida, Georgia, and South Carolina appears promising. Farmers will probably find it necessary to give more thought to consumer preference and appearance of their products and small farms are likely to become unimportant in total production. Farm specialization and mechanization should increase, and market facilities should become more specialized, efficient, and less numerous. Trucks will probably increase their dominance in transporting fresh produce unless railroads develop more rapid means of moving products. Florida citrus, especially oranges, may decline in relative importance on the fresh market in favor of sales to concentrate plants. No market area shrinkage is forecase for vegetable distribution.

With continued increases in population, urban growth, and levels of living, a periodic expansion of the fruit and vegetable industries in the states considered should be justified. Microfilm $3.15; Xerox $11.05. 243 pages.

SETTLEMENTS AND ECONOMIC LIFE IN THE WALKER RIVER COUNTRY OF NEVADA AND CALIFORNIA

(L. C. Card No. Mic 61-1969)

Earl William Kersten, Jr., Ph.D.
The University of Nebraska, 1961

Adviser: Leslie Hewes

This study is concerned with the geography of settlements and economic geography of the Walker River Country of western Nevada and eastern California. Like many localities in the Great Basin, the Walker River Country has varied mineral resources. Somewhat superior water and forage resources and nearness to California are advantages of the region. Since 1860, the beginning of

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Anglo-American settlement, mining, grazing, and irrigation, with changing emphases, have been basic to the economy.

Mining--important early, again during the first years of this century, and at present--has resulted in concentrated production and the establishment of numerous population centers, and has supported agricultural development, and required transportation and communication lines, some of which remain important. Few direct evidences remain of the numerous mining camps and towns, of which Bodie, Aurora, Pine Grove, Cameron, in the first period, and Mason, Thompson, and Ludwig in the second period, were the chief examples. Weed Heights is presently important as a new copper mining town. Precious metals, the chief objects early, have been replaced by copper.

Walker River agriculture is based upon the waters of the Walker River--for long quite completely used for irrigation, though not without waste--and the forage resources of unirrigated areas in the lowlands and uplands. Inadequate water supply has for long been the chief problem of agriculture; several attempts to expand land settlement have resulted largely in failures. The formation in 1919 of the Walker River Irrigation District and the construction shortly afterward of reservoirs extended the irrigation season and increased the reliability of water supply, but the problem of water shortages remains. Federal reclamation has been discussed, but no action has been taken. In 1960, during a drought, ground water was used on a considerable scale for irrigation for the first time.

Five types of farms are today most significant: (1) Livestock ranches, (2) smaller livestock farms, (3) dairy farms, (4) crop farms, and (5) diversified farms. Livestock ranches are the most widespread in occurrence. However, the other four types, restricted largely to Mason and Smith valleys, also make important contributions to commercial agriculture. Italian and Portugese immigrants are largely responsible for the introduction of dairy farming and specialty crops. Migrants and local Indians furnish much of the farm labor.

Mining should continue to be important in the Walker River Country; agriculture should not attempt to reclaim new lands, but should concentrate on improving the efficiency of water use on the present water right acreage. Finally, it is concluded that of existing towns, only Yerington, Wellington, and Central, all in agricultural areas, share a promising future.

Microfilm $5.80; Xerox $20.50. 453 pages.

RECENT POPULATION PATTERNS AND TRENDS IN THE REPUBLIC OF KOREA

(L. C. Card No. Mic 61-1760)

Chung Myun Lee, Ph.D.
University of Michigan, 1961

As is true for any developing nation, the Republic of Korea has many problems, the most severe and basic of which is rapid population growth and increasing population pressure.

Korean population remained relatively stable until the beginning of the Japanese occupation in 1910. During the next thirty years the population doubled, and has continued to increase at a rapid rate.

The population pattern is in general typical of an Asian agricultural economy, and is directly related to the distribution of agricultural land. The density reflects differential productivity of the land. Lesser concentrations are based on fishery resources, and the pattern of communications and urban centers.

The Korean population is homogeneous and growing rapidly at an annual rate of increase of 1.7%. The period of Japanese occupation was characterized by the alleviatory movement of population to undeveloped areas of Northern Korea, to Japan, and to adjacent areas of the USSR and Manchuria. Such movement is not possible today, and the Republic of Korea must provide for population increases within its own limited area.

A number of remedial measures are suggested in meeting Korea's population problem. Resettlement in newly developed agricultural areas, and migration are of little significance in crowded Korea. More important are moves to increase the agricultural productivity of land under cultivation, and to encourage industrial and urban development. These are means of expanding productivity, and perhaps creating situations in which the birth rate will be curtailed. Of even greater importance is the actual control of the birth rate itself. Birth control encounters moral, emotional, economic and philosophic resistance, and involves considerable effort to establish, but must be advanced as a key to the solution of Korea's population problem.

The population problem is not static, but dynamic. It seems unlikely that the present low rate of food consumption can be increased or even maintained if the rate of population growth is not reduced considerably. The heavy pressure of population on the land already exerts a strong brake on Korean economic development. It is a complex problem which can only be solved by the combined effort of all participating government agencies as well as the individual cooperation of every Korean.

Microfilm $2.95; Xerox $10.35. 228 pages.

THE AGRICULTURAL LAND USE OF THE WESTERN FINGER LAKES REGION OF NEW YORK: 1600-1959.

(L. C. Card No. Mic 60-6996)

Richard George Silvernail, Ph.D.
The University of North Carolina, 1960

Supervisor: J. Sullivan Gibson

The Western Finger Lakes region includes 3,182 square miles in west central New York State. Included within the study are the six counties of Genesee, Livingston, Ontario, Seneca, Wyoming, and Yates. The basis for delineating this region from the surrounding areas is that of agricultural land use. This is the only dairy and cash crop area in the entire Northeastern United States. Regionally, more than 75 percent of the total land area was in farms in 1954 – higher than any other section in the Northeast.

The percentage of harvested crop land is second in the Northeast only to the Lancaster County, Pennsylvania area. The crops grown in this region are much the same as those in other Northeastern areas, but the proportion of wheat and other cash crops is higher. More than 20 percent of the harvested crop land was in wheat in 1954, the highest in the Northeast.

Within the region, the dairy and cash crop combination varies in relation to the local environment. Where the land is level to gently undulating, where the growing season is over 145 days, and where the soils are fertile and well-drained, cash crops reach their maximum intensity, and dairy farming is at a minimum. In such localities, the amount of rainfall during the growing season determines the type of cash crop raised. In the drier areas, wheat and dry beans are most important, while in the wetter areas, truck crops are dominant.

Where the local topography is rough, where the growing season is under 145 days, and where soils are infertile or have restricted drainage, specialized dairy farming is dominant, and cash crops are relegated to a minor position. One exception is noted. In areas that receive the moderating temperature benefits from the larger Finger Lakes, fruits, especially grapes, become the major use of the land and dairy farming is at a minimum. Between these two extremes, the amount of land devoted to dairy or cash crops depends in a large measure upon how well the individual farm can adequately support each member of this combination.

The present land use patterns are a result of constant change which has taken place since the development of agriculture by the Seneca Indians over 350 years ago. This paper first evaluates the agricultural capabilities of the physical environment. Based on this evaluation, the series of agricultural adjustments are discussed by means of an historical approach. The effects of extended and improved lines of transportation and the growth of urban markets are traced. Changes in farm characteristics are noted and their basic causes explained. Land abandonment is discussed in terms of both the federal government's soil bank programs and the limited capabilities of the physical environment. Acreage controls, crop subsidies, and the New York State blended price system for milk are interpreted in the light of their effects on regional agriculture.

The Western Finger Lakes region is an example of an area that has been able to adequately meet the challenges posed by western competition, growing soil depletion, and plant diseases. That this region continues to be one of the most productive agricultural areas in the Northeast is a tribute both to a well endowed physical environment and to the progressive attitude of its farmers.

Microfilm $4.75; Xerox $16.90. 372 pages.

AN ANALYSIS OF THE LOCATION OF PHYSICIANS IN THE UNITED STATES FOR THE YEAR, 1950.

(L. C. Card No. Mic 61-1935)

Samuel Wallace Smith, Ph.D.
State University of Iowa, 1961

Chairman: Professor Harold H. McCarty

There has been a widely prevailing belief among geographers that service industries, including medical service, are distributed according to population. A review of the literature of the fields of medicine and sociology as well as statistical tests pointed up the fact that physicians were not evenly distributed throughout the United States in the year, 1950.

Hypotheses, deduced from the literature of Economics, Sociology, and Medicine, developed along the general lines: that physicians would tend to locate in areas characterized by stable economic conditions and away from industries subject to cyclic economic fluctuations; that they would also tend to locate in areas where adequate medical facilities, e.g., hospitals and laboratories, were readily available.

Economically stable conditions were operationally defined as industries characterized by their stability, while cyclically unstable conditions were operationally defined as industries characterized by their fluctuations. Among the stable industries were: communications, finance-insurance-real estate, utilities, and government. Among the economically unstable industries were: construction, coal mining, and primary metals (heavy industry). Adequate medical facilities were defined operationally, as the number of hospital beds, and the number of students in medical colleges. Income was included and measured by the effective buying income and the median family income of the given area.

Statistical techniques were utilized to determine the validity of the hypotheses. These techniques included linear correlation and regression, and multiple correlation and regression. The county was used as the basic unit in a universe which included all of the 3073 counties in the United States. From this a systematic, random sample of 103 counties was chosen, tested for its adequacy, and used to test the established hypotheses.

Total population, as an explaining variable, demonstrated a high statistical correlation (.r = .949) with physicians and a standard error of 87. When it was used in the regression formula it produced estimates with some interesting implications. The deviations from the regression line were such that the large, urban concentrations were generally underpredicted while centers of heavy industry and of coal mining were generally overpredicted.

When the other variables were tested in linear and multiple correlations, with and without total population, it was found that both total population and construction produced such high proportions of the explanation of the distribution of physicians and such great overlaps in the explanation that they were of little value in a multiple correlation. Neither measure of income demonstrated high statistical significance, nor did communications, utilities, or coal mining.

The most satisfactory combination of variables was that which included hospital beds, medical students, primary

metals, public administration, and finance-insurance-real estate. This produced a coefficient of multiple correlation which equalled .9998 with a standard error of 5. By using the regression formula the multiple variables were tested against the entire universe. A similar test was made with total population as a single explaining variable. When the results of these tests were compared it was found that the multiple variables estimated a larger number of counties more closely than did total population. While a great improvement was shown for the smaller medical centers and medical college cities, a much smaller improvement was shown for the larger urban centers. For the most part, estimates for centers of heavy industry were poorer than those provided by population, alone.

The study would seem to indicate that total population is not an adequate explanation of the distribution of physicians and, while the established hypotheses seemed to be valid, more work could be done in operationally redefining the variables used.

Microfilm $2.75; Xerox $6.80. 143 pages.

GEOLOGY

SEDIMENTARY PETROLOGY OF POST-MADISON-PRE-KOOTENAI ROCK, NORTH FLANK OF LITTLE BELT MOUNTAINS, MONTANA.

(L. C. Card No. Mic 61-1355)

William Wayne Ballard, Ph.D.
The University of Texas, 1961

Supervisor: Robert L. Folk

The rocks of the upper Mississippian Big Snowy group (Kibbey, Otter, Heath formations) were deposited in a regressing sea which occupied a marine trough that developed across central Montana during late Mississippian time. These rocks were deposited as beach, neritic, lagoonal and off-shore, quiet-water deposits. The sandstones of the Kibbey are supermature subarkoses, and those of the Heath are supermature orthoquartzites. The lower part of the Amsden formation (upper Mississippian and/or lower Pennsylvanian) is primarily a flood-plain (possibly deltaic) deposit; the sandstones of the section were deposited as beaches or as windblown sand along the beaches, and are supermature orthoquartzites. The limestones (ostracodal micrites and microsparites) of the upper part of the Amsden formation represent quiet, brackish water deposits.

The Jurassic Rierdon and Swift formations were deposited in an upper Jurassic sea. The Rierdon rocks represent quiet water deposits. The Swift sandstones are orthoquartzites and chert arenites and they range from submature to supermature. The sea was transgressing westward in the Little Belt area during deposition of the Swift rocks. The Morrison formation (upper Jurassic) was deposited in a variety of continental environments. The Lakota formation (lower Cretaceous) is a fluvial, alluvial-fan deposit, consisting of immature to mature chert arenites and orthoquartzites.

The primary source of the Paleozoic units was the granitic rocks of the Siouxia arch (Transcontinental arch) and Canadian shield to the east of central Montana. The Mesozoic units were derived largely from sedimentary rocks to the west. The climate gradually changed from arid during Kibbey deposition to humid during deposition of the upper Heath and Amsden. The Mesozoic rocks were probably deposited under humid conditions.

Microfilm $5.55; Xerox $19.80. 436 pages.

THE ECONOMIC GEOLOGY OF SOME VIRGINIA KYANITE DEPOSITS

(L. C. Card No. Mic 61-2115)

Paul Joseph Bennett, Ph.D.
University of Arizona, 1961

Supervisor: W. C. Lacy

The kyanite quartzite deposits at Leigh, Baker and Willis Mountains located in the south central Virginia Piedmont were investigated to determine their genesis, extent, and geologic and petrographic character. Kyanite quartzite in Virginia typically contains 20-40 per cent kyanite, 0-5 per cent pyrite, 0.5-1.5 per cent rutile, a per cent or so of mica or clay with the balance quartz. They occur as single beds within metamorphic rocks ranging from slates and phyllites of the greenschist facies south of Leigh Mountain, to schists and gneisses of the amphibolite facies at Baker and Willis Mountains. Post-kyanite hydrothermal alteration along fractures has altered large segments of the Baker Mountain deposit to clay and topaz.

The protolith of kyanite quartzite is believed to have been extraordinarily pure mixture of quartz and kaolinite which was produced by either lateritic weathering or by circulating meteoric waters. Isochemical regional metamorphism is believed to have occurred in a high pressure, moderate temperature environment in which water was either deficient or able to escape. Fluorine may have had a catalytic effect in promoting kyanite crystallization. No evidence was found of hydrothermal introduction of alumina, or localization of kyanite as a result of differential stress.

The rocks enclosing kyanite quartzite in the Leigh Mountain area are believed to be basal members of the lower Paleozoic (?) Volcanic-Slate series. The gneisses surrounding Willis and Baker Mountains may be more

highly metamorphosed, infolded remnants of the same series.

The kyanite deposits of Virginia are extensive and well situated for mining. Possible reserves of kyanite quartzite containing over 25 per cent kyanite available for open pit mining are measured in tens of millions of tons.

Microfilm $2.75; Xerox $7.60. 163 pages.

SURFICIAL GEOLOGY OF THE VERMILION AREA, ALBERTA, CANADA.

(L. C. Card No. Mic 61-1610)

Robert Brian Ellwood, Ph.D.
University of Illinois, 1961

The surficial deposits of the Vermilion area of east-central Alberta consist primarily of Pleistocene glacial sediments. No evidence of multiple glaciation was found in the area. A late Wisconsinan age is assigned to the deposits.

The glacial sediments are underlain by the Upper Cretaceous Lea Park and Belly River formations. First order topography is a reflection of the regional bedrock topography which is thought to be little changed from its pre-Pleistocene aspect. The pre-Pleistocene landscape consisted of uplands underlain by more resistant sandstones and broad lowlands underlain by shale. The topographic configuration of the bedrock influenced the direction and rate of glacier flow in the initial stages of glacierisation when the ice was relatively thin. The regional slope to the east and northeast affected the deposition of Pleistocene sediments both during the upslope advance and downslope retreat of the glacier. In many places, the bedrock was severely contorted by the weight of overriding ice, and much bedrock was incorporated into the ice as till. The erosive capacity of the continental ice sheet may have been instrumental in removing all traces of any earlier glacial deposits.

Aerial photograph studies of flutings in the northern 2/3 of Alberta indicate that the regional ice advance was from the Keewatin area to the northeast. Late phase reactivation of the ice produced southeasterly trending flutings in the Lea Park ice-stream zone. Flutings were produced by erosion and remolding of till deposited by the regional ice advance. The ice stream was a linear zone of active ice some 15 miles wide and more than 200 miles long, and bounded on both sides by stagnant and stagnating ice. Bedrock in areas adjacent to the ice stream was contorted into ridges normal to the fluting direction.

Ice in the Vermilion area is thought to have attained a thickness of 3500 feet. Deglaciation proceeded by widespread stagnation of a broad marginal zone which migrated initially to the northeast and later to the north. Stages in the deglaciation history are marked by successively lower meltwater channels rather than by recessional moraines.

Only one till is recognized in the Vermilion area and its composition is fairly uniform throughout. The different geomorphic aspects assumed by the till represent morphological variations of material deposited essentially contemporaneously by the same ice sheet. The different morphological aspects are thought to represent variations in the amount and vertical distribution of englacial and superglacial debris deposited from stagnating ice. Debris was carried to higher positions in the ice in places of obstructed flow. Hummocky moraine topography was produced by downwasting and topographic inversion of the ice surface.

Crevasse fillings are oriented normal to the direction of ice flow. They are composed mainly of till and are gradational into hummocky moraine. They represent deposition of material by an ablation mechanism in cracks which reflected the stress distribution inherited from the active Lea Park ice stream.

Most meltwater was confined in ice-walled channels. Large right angle bends along meltwater channels were formed as meltwater flowed through cracks in the ice. Successive reaches between right angle bends are aligned normal and parallel to the direction of ice flow. Buried channels in hummocky moraine areas were filled by glacial debris as the ice walls collapsed.

Patterned ground in the form of sand-wedge polygons indicates that periglacial conditions existed for a fairly long period after deglaciation.

Ground water supplies are developed from outwash deposits, pockets of sand and gravel in till, and from sandstone members of the Belly River formation. Recharge to aquifers is thought to be slow because of low precipitations and low permeability of most of the surficial deposits. Microfilm $2.75; Xerox $7.40. 159 pages.

STRUCTURE AND STRATIGRAPHY OF THE NORTHERN EGAN RANGE, WHITE PINE COUNTY, NEVADA.

(L. C. Card No. Mic 61-1319)

William Harold Fritz, Ph.D.
University of Washington, 1960

Chairman: Peter Misch

In the northern Egan Range, central-east Nevada, a 400-square mile map area contains Late Precambrian through Permian strata. These strata are in part repeated in four structural units as a result of Mesozoic thrusting. Each unit is a portion of a major thrust sheet that contains rocks of a different miogeosynclinal facies. The lowest major thrust may, or may not, represent a basal décollement as suggested by Misch and Easton (1954).

The structural unit below the basal? décollement, Unit I, contains over 4,600 feet of slightly metamorphosed Late Precambrian shale and quartzite that is described and divided into eight formations, four of which correlate with stratigraphic units in the Schell Creek Range. Also included in this unit is the lower portion of the Prospect Mountain quartzite of Early? Cambrian age.

The second structural unit directly overlies the basal? décollement. This unit consists of Lower Cambrian through Middle Ordovician strata. The Middle Cambrian strata are described, and they are thought to represent a more easterly facies than the Middle Cambrian of the next higher unit. These rocks of Unit II are similar to the Middle Cambrian of the southern Snake Range 60 miles to the southeast.

Unit III overlies both I and II. It contains Late

Precambrian through Permian strata that are described and divided into 25 formations. The Late Precambrian formations correlate with those of Unit I; variances between formations in the two structural units are attributed mainly to the relative displacement of the units. The Cambrian succession is similar to that of the Eureka District, 50 miles to the west. Lower and Middle Ordovician strata of the Pogonip group are subdivided into six formations which resemble six Pogonip formations in the Ibex Area, Utah, but only two are correlated. All of the younger Paleozoic formations except one of Upper Ordovician and Silurian age are correlated with well-known stratigraphic units in the eastern Great Basin.

The highest structural unit, IV, consists of unmeasured Upper Ordovician through Devonian strata that closely resemble rocks of this age in the Cherry Creek Range which adjoins the area to the north. Also, the mild degree of deformation resembles that to the north; therefore, the rocks of the Cherry Creek Range are tentatively included in Unit IV.

During the Mesozoic orogeny, the units above the basal? décollement yielded to the east relative to Unit I below, and relief is thought to have been present on the upper surface of Unit I at the time of thrusting. It is proposed that Unit II filled a low on this surface and was truncated by Unit III. Unit III wrapped around a high, filled a second low, and partially overrode itself. Unit III was, in turn, overridden, at least in part, by Unit IV.

During Tertiary deformation, a block fault uplifted the range and tilted the rocks to the west. Part of the area may have also been uplifted in the shape of an elongate dome as Mesozoic thrusts parallel the flanks of the range.

Tertiary volcanics cover an area totaling 3 square miles. They are mapped as one formation, but they are described separately as consisting of rhyolite and andesite? ignimbrites and an andesite flow.

Microfilm $2.75; Xerox $8.20. 178 pages.

THE GROUNDWATER GEOLOGY AND HYDROLOGY OF WASHTENAW COUNTY AND THE UPPER HURON RIVER BASIN

(L. C. Card No. Mic 61-1758)

George Robert Kunkle, Ph.D.
University of Michigan, 1961

This study evaluates the supply and use of groundwater in an area in southeastern Michigan. It also makes an attempt to locate new aquifers there. Primarily, the study is limited geologically to the glacial drift and hydrologically to the Upper Huron River basin.

The geologic interpretations are based on both previous investigations and available well records. The information indicates that the glacial drift varies between 10 and 600 feet in thickness with an average of about 200 feet. The drift includes Cary deposits from both the Saginaw and Huron-Erie ice lobes. The Cary deposits have the greatest groundwater potential in Livingston and Oakland Counties where extensive outwash plains of considerable thickness are found. Qualitatively, the potential of these plains is compared with other areas by flow-duration curves. The comparisons indicate that the Saginaw ice deposits have greater amounts of available groundwater than do the Huron-Erie deposits.

Beneath the Cary deposits are pre-Cary(?) tills, separated on the basis of lithology. The surface on top of the pre-Cary(?) till is contoured for eastern Washtenaw County, where it is incised by a deep channel. Permeable deposits found within the channel serve as excellent aquifers in Ann Arbor and Ypsilanti Townships.

The bedrock surface is contoured and is also found to be deeply incised by channels. The deposits within these channels are at present neither well known nor extensively used as a source of groundwater. The similarity between the bedrock, the pre-Cary(?), and the present topographies suggests that the older topography strongly influenced the formation of the younger.

In Washtenaw County, permeable deposits immediately underlie the present Huron River. The deposits fill a post-Cary channel cut during a low lake stage in the Erie basin. Direct recharge from the Huron River permeates the post-Cary deposits, and, in a few instances, also permeates the underlying pre-Cary(?) channel fills.

The hydrologic studies are based on the use of the hydrologic equation of equilibrium, hydrographs and base flow depletion curves for the Huron River at Ann Arbor, as well as water use per capita estimates. The amount of groundwater readily available in the Upper Huron River basin is estimated at 0.85 inches per year. Present well withdrawal is 30 percent of this amount, and drain diversion accounts for another 30 percent. Assuming that drain diversion does not interfere with well withdrawal, the amount of water available should be sufficient until approximately the year 2010. When the demand exceeds the amount of readily available groundwater, the water table will progressively decline. Groundwater use has already caused both local water table declines and an increase in the rate of base flow depletion of the Huron River.

Microfilm $3.50; Xerox $12.15. 270 pages.

PRECAMBRIAN GEOLOGY OF THE LAKE CARHEIL AREA, SAGUENAY ELECTORAL DISTRICT, QUEBEC.

(L. C. Card No. Mic 61-1769)

Daniel Lawson Murphy, Ph.D.
University of Michigan, 1961

Recent geologic investigations along the southwestern extension of the Labrador Geosyncline either have been confined largely to the iron ore deposits or are broad, regional studies. The present work is, in a sense, a compromise between the two extremes. Field mapping on a scale of two inches to a mile supplemented by detailed laboratory study has provided a wealth of data concerning the local aspects of the geology, whereas the systematic exploration of nearly 500 square miles has enabled the author to trace out subtle lithologic and structural changes that have not been fully recognized in regional investigations.

The Lake Carheil area is underlain by bedrock of Precambrian age. The oldest and most abundant lithologic group, the Lower Gneiss-Schist complex, is composed of a mixed biotite gneiss at the base and a banded

biotite paragneiss at the top locally separated by a thin, discontinuous zone of paraschist. Certain features in the mixed gneiss suggest that it has been subjected to more than one period of alteration and deformation. The distinct layering of the paragneiss, resulting from a compositional alternation, parallels the structural attitudes of the overlying and underlying formations. Partial chemical analyses of the paragneiss suggest that a graywacke-slate sequence constituted the parent material; less likely, the antecedent materials were soda-rich shales and siltstones. Apparently, the paragneiss and paraschist were involved only in the period of deformation, metamorphism, and intrusion which affected the Iron-Formation group and most of the younger rocks. These rocks have been assigned a Proterozoic age, whereas the mixed gneiss is tentatively considered to be Archean.

Metamorphosed iron-formation, marble, and quartzite are referred to as the Iron-Formation group. They are exposed primarily along the flanks of large folds in the central and southwestern sections of the area. Marble and quartzite, largely contemporaneous time-rock units, form the lower portion of the group. The iron-bearing rocks consist of an oxide facies which occurs with the quartzite and a much more widespread silicate-carbonate facies generally associated with the marble. The quartzite-iron oxide association was derived from the alteration of a nearshore section of chert and banded chert alternating with layers of iron oxide. Deeper water sediments consisting of cherty limestone and dolomite overlain by a succession of iron silicates and carbonates interstratified with chert were the antecedents of the marble-silicate-carbonate sequence. A post- iron-formation conglomerate is the youngest formation of the group.

Biotite-quartz-feldspar schist is the principal formation of the Lake Carheil group. The remainder of the group consists of hornblende paragneiss and paraschist together with mica-quartz schists. The latest rocks that formed prior to metamorphism were originally basic intrusives or, perhaps in places, lavas and tuffs, which have been transformed into amphibolite, hornblende gneiss and hornblende schist.

Granitic intrusion, mainly synchronous with deformation and metamorphism, gave rise to a complex association of acid dikes, gneissic granite, and mixed gneisses. Small stocks, ranging in composition from pyroxenite to monzonite, are relatively unaltered indicating that they are the youngest rocks in the area.

Metamorphism and orogeny were largely contemporaneous. The major north-south and east-west trending folds are traversed by northwesterly directed cross folds. Various joint and fault systems together with metamorphic structures are associated with the fold patterns. The areal structure can be related to a single period of deformation during which compressive forces were directed from the southeast.

Originally, the Lake Carheil area was part of an unstable geosynclinal belt extending from northern Quebec to Lake Mistassini. Following sedimentation and volcanism the rocks were involved in one or more periods of orogeny, the latest culminating about 900 million years ago.

Microfilm $2.75; Xerox $9.00. 198 pages.

GEOLOGY AND MINERAL DEPOSITS OF THE GALLINAS MOUNTAINS, NEW MEXICO.

(L. C. Card No. Mic 61-1822)

Ralph Matthew Perhac, Ph.D.
University of Michigan, 1961

This study was undertaken to determine the stratigraphy, structure and igneous petrology of the Gallinas Mountains in central New Mexico. An investigation in this part of the state, which had previously received little attention, should elucidate regional Permian paleogeography and should lead to a better understanding of the post-Cretaceous tectonic disturbances and igneous activity of the central New Mexico mountainous areas. In addition, the extensive epigenetic mineralization afforded the opportunity for a detailed study of the mineralogy and structure of the deposits with the hope of determining their origin. In particular, a study of the relatively rare mineral bastnaesite might yield more information about its occurrence and significance as a temperature-pressure indicator.

Two summers were spent in detailed mapping of the geology and mineral deposits. This was followed by a laboratory study (mainly petrographic) of the rocks and selected ore suites.

The Gallinas Mountains are underlain by lower Permian sedimentary rocks that were intruded by early Tertiary(?) hypabyssal intrusives. The presence of Permian strata directly on Precambrian granite indicates that this area was part of the Padernal landmass, a positive area that persisted over much of central New Mexico throughout late Paleozoic time. The sedimentary sequence is typically transgressive, grading upwards from Abo basal arkose through continental feldspathic sandstones of the Yeso formation into the beach or shallow water marine Glorietta quartzose sandstones. Because of a southward facies change into lagoonal and marine beds, the Gallinas transgressive sequence indicates a northward advancing sea throughout lower Permian time. By middle Permian time, the shoreline had migrated from southern New Mexico to the vicinity of the Gallinas Mountains.

The Permian beds were uplifted, domed, and faulted by early Tertiary(?) intrusives, primarily alkalic trachyte and rhyolite laccoliths. The high Na_2O content of the igneous rocks is evident from the abundance of highly-sodic plagioclase and by the extensive deuteric albitization. Despite the extensive igneous activity, contact metamorphism of the sedimentary rocks is minor. In addition to those in the Gallinas mountains, a number of similar hypabyssal intrusives are present in central New Mexico, thus suggesting that a distinct Laramide subsilicic alkalic intrusive province may exist in this part of the state. The Laramide age of the tectonic activity is based on the type of deformation (domal uplift) and on the similarity of the igneous activity to that of the eastern Rocky Mountain Laramide intrusive areas of Montana, Colorado, and Texas.

Associated with the trachyte of the Gallinas Mountains are many iron and fluorite-copper deposits. The iron occurs as magnetite-hematite replacement lodes in gypsiferous limestone or in diopsidetremolite skarns. The contact metamorphic lime-silicate assemblage and the presence of magnetite with possibly nondehydrated gypsum suggest that the iron deposits may have formed

at temperatures as low as 200-250°C. The fluorite-copper deposits are typical low-temperature epithermal fissure veins and breccia fillings in Yeso sandstone. The rare-earth fluocarbonate, bastnaesite, is present in many of the fluorite deposits. This mineral had previously been reported mainly from high-temperature deposits. The Gallinas occurrence and other recent ones throughout the world, however, indicate that bastnaesite may form under a variety of temperature-pressure conditions and can no longer be considered critical.

Despite the large number of mineral deposits, the economic potential of the Gallinas district is limited at the present time. The better iron deposits have been almost completely exhausted. Although fluorite, copper minerals, and bastnaesite are common, the total reserves of these minerals is small and most deposits are neither large enough nor of sufficiently high tenor to be commercially valuable under present market conditions.

Microfilm $3.35; Xerox $11.70. 259 pages.

MICROFACIES STUDY OF THE RUNDLE GROUP, FRONT RANGES, CENTRAL ALBERTA.

(L. C. Card No. Mic 61-1676)

Robert Leonard Walpole, Ph.D.
University of Illinois, 1961

The Rundle Group (Mississippian) of Western Alberta consists of a predominantly clastic carbonate sequence exhibiting variations in texture and composition which, when analyzed by petrographic methods, reveal rhythmical changes of environments of deposition and provide means for correlation.

Over 800 thin sections were studied from three sections in the front ranges of the Rocky Mountains of the Ram River area. The indices of clasticity and frequency were determined for crinoid fragments, pellets, oolites and quartz grains, and curves for each of the parameters were plotted. The presence of arenaceous foraminifera, bryozoan fragments, algae, sponge spicules and echinoid spines were recorded.

The statistical data, combined with the distribution of the detrital matrix and biochemical cement reveal five microfacies which represent different environments of deposition, ranging from a shallow lagoonal environment to a deep open marine environment. Microfacies 1 is the deepest facies and consists predominantly of small crinoid fragments and sponge spicules in a fine bioclastic and argillaceous matrix. Microfacies 2 represents a more shallow environment which is transitional between microfacies 1 and 3, the latter consisting of oolites and well rounded, well sorted crinoid fragments and pellets in a clear calcite cement. Microfacies 4 consists almost entirely of interlocking crinoid fragments, whereas microfacies 5 is characterized by calcilutite with scattered crinoid fragments and oolites. Locally this microfacies may be entirely pelletoidal.

The variations of the parameters of the measured components in relation to each other produce a consistent rhythmic pattern of curves when the microfacies are superposed in a succession from 1 to 5 or 5 to 1, indicating that such a succession expresses an ideal cycle, which has been interpreted laterally as a lagoonal environment (microfacies 5) grading into a zone of crinoid colonies and agitated water (microfacies 4) which in turn grades into a succession of environments of gradually deepening water in which mechanical distribution of the particles is predominant (microfacies 3 to 1).

The ideal cycle was used for the analysis and construction of a relative bathymetrical curve for each section. General trend curves were drawn to stress the over-all evolution of the sequences, on the basis of which correlations were made, which afford more detail than megascopic field correlations, but are in general agreement with them.

A comparison of corresponding microfacies of the three sections indicate two conditions of the sea floor: either a slope in which the eastern portion was consistently more shallow than the western, or a horizontal condition during which time all the sediments were laid down under the same depth of water.

Microfilm $2.75; Xerox $5.60. 111 pages.

GEOLOGY OF THE CASTINE-BLUE HILL AREA, MAINE.

(L. C. Card No. Mic 61-1680)

Paul Sidney Wingard, Ph.D.
University of Illinois, 1961

The Castine-Blue Hill area lies near the central part of the Maine coastal region on the east side of Penobscot Bay. The rock bodies in the mapped area consist of low grade metamorphic rocks, pyroclasts, acid igneous intrusions, acid flows, and minor igneous dikes.

Thermal metamorphism has been imposed locally upon the Ellsworth schist, Castine volcanics, and Panobscot formation by a dioritic body and six granitic bodies. The oldest formation, the folded Ellsworth schist, displays, near the intrusive contacts, a combined regional and thermal metamorphism. The thermal metamorphic rocks exhibit andalusite, cordierite and anthophyllite, which are minerals characteristic of the hornblende hornfels facies. Prior to both metamorphic changes, the Ellsworth schist was a series of pelitic and quartzose sediments with acid flows and pyroclasts abundant, particularly in the lowest portion now exposed.

Unconformably overlying the Ellsworth schist is the folded Castine volcanics, a series of acid flows and pyroclasts, which locally displays slaty cleavage and is weakly metamorphosed. On Condon Point near South Brooksville the limited extrusive "greenstones" of the Castine volcanics display a well-developed pillow structure.

The youngest major rocks, diorite and granite, cut all rocks in the area except analcime lamprophyre, aplite, and the youngest basic dikes. The granite plutons are cupolas of a batholith and are separated on the erosional surface by the Ellsworth schist. Erosion of the granites has not been deep and, therefore, permits observation of primary foliation, joints, and aplite dikes. Also associated with the granites are the effects of hydrothermal alteration on the country rock and late stage deposition of copper, zinc, iron and minor quantities of other metals.

Near South Penobscot, an older dioritic body now forms an enclosing elliptical body about a younger biotite granite. Although diorite predominates within this earlier intrusive mass, the composition of the body ranges from quartz monzonite to gabbro.

Basic dikes, which cut all rocks in the area, are used for relative age correlation. The dikes may be divided into four sets on the basis of trend and mutual relations: set I, N 45°-85° W, set II, N 0°-30° E, set III, N 5°-30° W, and set IV, N 15° -80° E. Set I is pre-regional metamorphism, and sets II, III, and IV are post-regional metamorphism.

Between Brooklin and Surry the Ellsworth schist forms a very broad, southeasterly plunging synclinorium with crinkles developed on the chlorite schists. West of Brooklin, along Eggemoggin Reach, the Ellsworth schist constitutes a southeasterly plunging anticline. The regional foliation of the Ellsworth schist formed prior to Niagaran time, because fossiliferous, folded Niagaran strata 17 miles to the southwest, on North Haven Island, remain unmetamorphosed.

The Castine volcanics in the western part of the area are exposed in a synclinorium that trends N 30°-50°E. Although many small vertical folds are present, the regional structure is a shallow synclinorium. East of the Bagaduce River along the Narrows the Castine volcanics-Ellsworth schist contact is exposed. The Castine volcanics and the Ellsworth schist are separated by a conglomeratic quartzite with rounded quartz pebbles and subrounded lithic fragments of boulder size.

A tentative age correlation based upon lithology, structure and basic dikes has been established as follows: Ellsworth schist and Penobscot formation (?), pre-middle Silurian: Castine volcanics, middle or late Silurian; diorite, early or middle Devonian; Oak Point granite, Devonian; and biotite granite, Mississippian (?).

Microfilm $2.75; Xerox $7.00. 147 pages.

HEALTH SCIENCES

HEALTH SCIENCES, GENERAL

CONFLICT AND ORGANIZATION: SOME ASPECTS OF CONFLICT IN HOSPITALS.

(L. C. Card No. Mic 61-1926)

Samuel Levey, Ph.D.
State University of Iowa, 1961

Chairman: Professor Gerhard Hartman

Understanding the nature of organizational conflict and its sources and boundaries serves to relate major problem areas as they are evident within the hospital. A major object of the work is to locate disruptive factors in the hospital enterprise with eventual perspective directed toward reappraisal and re-evaluation of existing structures.

The investigation is based upon elicitation of response by means of a comprehensive questionnaire and subsequent limited interviews. The respondents are categorized in terms of three major hospital groups: administrators, directors of nursing service, and physicians.

Conflicts of attitude and ideology may account for a major proportion of the group and interpersonal differences which arise in the hospital. It is proposed that resolution of such conflicts must be primarily founded upon: (1) superior strength of educational background among professionals and paramedical personnel in the hospital, and (2) excellence of management in the organization.

Conflicts due to space and fiduciary allocation are frequent in hospital operation. Marked status differences, scarcity of qualified nurses, and low salaries are factors which may predispose the environment toward greater manifestation of conflict. Conflict often enhances the quality of the organization by promoting and effecting change measures.

Public opinion, union activity, and government intervention will influence the hospital of the next decades to significantly greater degrees; and administrators and professionals must be prepared to meet these challenges. Conflicts will arise and must be faced with a view toward resolution and organizational benefit.

The hospital industry is fifth largest in the country. Widespread organizational and social research in this vast complex must be undertaken and supported in the future.

Microfilm $3.80; Xerox $13.50. 296 pages.

THE POSSIBLE INFLUENCE OF THE HEALTH CARE DESIRES OF LABOR ON THE ADEQUACY OF FUTURE HOSPITAL FACILITIES

(L. C. Card No. Mic 61-1929)

Thomas McCarthy, Ph.D.
State University of Iowa, 1961

Chairman: Professor Gerhard Hartman

Leaders of labor speak for their members, and their members constitute a majority of the consumers of hospital care. In reality, the health care desires of labor can be considered the health care desires of society as a whole. It is thus that the whole of society has a voice pleading its cause inasmuch as what labor desires for its members is actually what is good for all of society. Labor has become the most influential and the greatest single voice to

formulate a definite set of health care desires. The perplexing task that faces labor leaders as well as medical, hospital, insurance and government leaders is how to fulfill the health care demands of labor.

The provision of health care facilities commensurate with the health care desires of labor and society in general presents a problem of great complexity. Any truly adequate solution to this problem presupposes a correct understanding of the problem itself in all of its manifold phases. This problem together with its various ramifications has been treated in general in this study. In order to contribute in some positive way to a fuller understanding of the total problem, one particular phase of the problem, namely, the possible effect of the health care desires of labor on the adequacy of future hospital facilities, has been submitted to an extensive investigation.

The result of this investigation not only manifests the present status of this particular phase of the labor health problem, but also indicates what is to be expected in the future and suggests what must be done if adequacy of hospital facilities is to be attained.

Microfilm $3.70; Xerox $12.85. 285 pages.

A DETERMINATION OF THE DISCRIMINATORY POWER OF HIGH SCHOOL SENIORS TO EVALUATE COMMERCIAL ADVERTISEMENTS IN POPULAR PERIODICALS UPON THE AUTHENTICITY OF THEIR HEALTH VALUE CLAIMS

(L. C. Card No. Mic 60-6432)

Edward Mileff, Ed.D.
Boston University School of Education, 1960

Statement of the problem.--The purpose of this study was to determine how well high school seniors could evaluate the authenticity of health claims made in advertisements from current popular periodicals. The achievement of this aim required: (1) construction and evaluation of an instrument for determining the ability of high school seniors to evaluate the authenticity of health claims for products advertised in current popular periodicals; and (2) analysis of student responses to the advertisements' health claims in the light of the ratings of juries of experts, who evaluated and validated the advertisements for use in the investigation.

Procedures.--In constructing the instrument to achieve the aim of the study, 152 advertisements for health products were collected over one calendar year from current popular periodicals and categorized under five topical areas to facilitate their evaluation and validation by juries of experts.

Four experts in each topical area--among whom were included 13 Medical Doctors, four Dentists, two Ph.D's, and one D.Sc.--evaluated the advertisements in their field upon the authenticity of their health claims. Ratings assigned were: (1) completely sound and accurate; (2) largely factual; (3) half true; (4) largely misleading and misrepresentative; or (5) completely distorted and deceptive. An advertisement for which there was at least 75 per cent agreement among the jurors' ratings was considered validated for use in the instrument, the authenticity of its health claims having now been determined.

Forty-seven of the 48 validated advertisements comprised the instrument. Organized in two parts and administered at separate classroom sessions, the instrument was initially tried with 96 students to determine its operational character. Its rating scale was similar to that used by the experts. A total of 881 high school seniors evaluated all the advertisements that made up the instrument during February, 1960. Thirty-nine other students, who finished one part of the instrument, were absent during the administration of its other half, and were not included in the statistical analyses. The entire group of 920 pupils was made up of seniors attending seven of the eight principal high schools in an industrial metropolitan area in Western Pennsylvania.

Findings and conclusions.--Analysis of data indicated: The mean number of incorrect responses by the students was 75.34 per cent. Of this mean of the total number of incorrect responses, 37.77 per cent were two or more degrees from the judgment of the experts on the rating scale, indicating marked errors. Thirty-four per cent or more of the high school seniors were two or more degrees from the rating of the experts on 26 of the 47 advertisements. Thus, substantial numbers of high school seniors demonstrated low discriminatory power in evaluating the advertisements' health claims.

The students generally attached a greater degree of credulity to the health claims than is justified, according to the ratings of the experts. In 40 of the 47 evaluations the high school seniors accepted, to a greater degree than the experts, the health claims of the advertisements. In only one instance was there no variation of the mean rating of the students from the rating of the experts. For 29 of the 47 advertisements, this variation was more than $\pm$ 1.0 degree on the rating scale.

The girls demonstrated greater ability in evaluating the health claims in periodical advertisements than the boys, to a significant degree. Analysis of variance also indicated highly significant differences among the students of the different schools. Health or hygiene courses taken in secondary schools had no significant bearing upon the student scores.

The instrument, which functioned as intended, is valid and has marked--if limited--reliability. The reliability coefficient (.678) was determined by the odds-evens split-half method, utilizing the Spearman-Brown prophecy formula. Microfilm $2.75; Xerox $5.00. 97 pages.

HEALTH SCIENCES, DENTISTRY

PREVALENCE AND SEVERITY OF PERIODONTAL DISEASE IN A SAMPLE OF A POPULATION

(L. C. Card No. Mic 61-2198)

Homer Claude Jamison, Dr.P.H.
University of Michigan, 1961

A probability sample of the population of Tecumseh, Michigan, was utilized to study the prevalence and severity of periodontal disease and the methods which Russell and Ramfjord have provided for assessing the disease. Scores of PI (Russell) are secured by quickly examining and scoring the periodontal tissues associated with each tooth present. Scores of PDI (Ramfjord) are secured by thoroughly examining and scoring the periodontal tissues of six teeth which Ramfjord specified as representative of the periodontal tissues of the individual. For each type of score the ratio of the sum of the scores to the number of the teeth present is the score for the individual. More information was desired about the distributions of these two types of scores, their relationships, and the distribution of periodontal disease in a population.

The sample was composed of 801 people older than four years of whom 690 people, or 86.1 per cent participated in the study. Scores of PI, PDI for the specified teeth, and PDI for all of the teeth were obtained for the 690 participants.

By each method of assessing periodontal disease, more than 95 per cent of the children who had primary teeth had periodontal disease to some extent. Almost all of the people who had permanent teeth had periodontal disease, that is, either destructive periodontal disease or gingivitis. The prevalence of destructive periodontal disease was greater for people of lower educational status than for higher status and increased with age. The over-all rates of prevalence of destructive periodontal disease by the criteria accepted for scores of PI, PDI for the specified teeth, and PDI for all of the teeth were 17.8, 59.5, and 62.9 per hundred respectively.

Tests of the skewness and kurtosis of the distributions of scores of PI revealed that data of these scores for all people within the various age groups may not satisfy the assumption of normality for the "t" test, normal deviate test and analysis of variance, but tend to be skewed positively. The distributions of scores of PI for people who have destructive periodontal disease satisfy the assumption of normality. The tests of skewness and kurtosis of scores of PDI revealed that the distributions of these satisfy the assumption of normality for the three tests of significance.

The severity of periodontal disease increased with age and the severity of the disease was greater in males older than 25 years than in females of the same age.

The study of coefficients of correlation and comparisons of means and standard errors revealed that scores of PDI for the specified teeth closely approximate scores of PDI for all of the teeth. When information from radiographs is substituted for information secured by measuring the gingival sulci for scores of PDI, the resulting scores are smaller.

Conclusions from the study follow: (1) scores of PDI for the specified teeth approximate scores of PDI for all of the teeth; (2) the distributions of scores of PDI satisfy the assumption of normality for "t" tests, normal deviate tests, and analysis of variance; (3) the extent of destruction of periodontal tissues can be estimated more precisely be measuring gingival sulci than by utilizing information from radiographs alone; (4) the prevalence of destructive periodontal disease increases with age; (5) the severity of periodontal disease tends to increase with age and to be greater in males older than 25 years than in females of the same age; (6) only a small proportion of the people who have the disease are aware of its presence.

Microfilm $2.75; Xerox $7.60. 164 pages.

HEALTH SCIENCES, PHARMACY

A PHARMACEUTICAL INVESTIGATION OF SELECTED ALBERTA BENTONITES

(L. C. Card No. Mic 61-1311)

Arthur James Anderson, Ph.D.
University of Washington, 1960

Chairman: Elmer M. Plein

Twenty-nine samples taken from bentonite deposits throughout Alberta were studied with a view to determining the presence of reserves of pharmaceutical grade material within the province. All were identified as bentonites by qualified mineralogists. Verification by differential thermal and X-ray techniques was later made on a selected group of ten samples.

A rigorous chemical analysis was not undertaken since pharmaceutical requirements were based primarily upon the inherent physical properties of the material. However, certain chemical procedures were completed to aid in characterization of the material.

Alkalinity tests indicated some clays were below standard. However only five of these were considered as probably indicative of substandard beds.

Alberta bentonites were found to be practically free of arsenic, making the clays suitable in this respect for use in medications to be taken internally. Cation exchange capacities were determined by the ammonium acetate leaching method, yielding values generally lower than those obtained for the control. Exchanged ions were studied by flame spectrophotometric techniques. Results indicated generally low potassium and magnesium, with variation in sodium and calcium values. Rosalind clays were low in soluble salts, while samples from other areas varied considerably in this respect.

Potentiometric titrations with standard sodium hydroxide were undertaken. Values were graphed and each curve was analyzed. Inflection points, pKa values, buffer capacities and cation exchange capacities were compiled in table form. Differences observed served to emphasize the variation in lattice charges among the montmorillonites concerned. Exchange capacities read from these curves were greatly reduced from those obtained using the ammonium acetate procedure.

The presence of free iron oxides in the clays was

considered as undesirable and an analysis of 16 samples was undertaken. Two Rosalind clays were very low in such contamination but a third, collected from the exhaust stack of the Rosalind plant, was rich in iron oxide, thus contributing to the tan color of the powder.

Physical properties studied were considered to be particularly important. Swelling tests were conducted on each clay, with results indicating many were of the medium or low-swelling types. Seven clays met official standards for swelling power, five of which were from the Rosalind lease. Concentrates were prepared by water sedimentation to compare relative swelling powers of the respective clay fractions contained in the native materials. Results indicated that high swelling fractions existed in some of the deposits.

Samples were then subjected to a mechanical analysis to determine the amount of sand, silt and clay present. Many of these contained relatively high sand contents, while three were exceptionally clean in this respect. Low silt and high clay contents were found in four samples, all from the Rosalind beds. Clay and silt fractions offered a good basis for comparison of quality.

Twenty-one clays were tested for gel-forming ability. Seven clays were found to equal or exceed the minimum requirements of the B. P. Three of these had previously shown unsatisfactory swelling powers.

On the basis of the official limit tests employed, one sample was considered of pharmaceutical quality. One sample from the same bed was below standard only in pH.

Sedimentation studies were conducted using Calamine Lotion, B. P., with and without phenol, Calamine Lotion U. S. P. and Chalk Mixture, N. F. Four clays proved to be of value as suspending agents for the Calamine Lotions, but none was found acceptable for the Chalk Mixture.

Viscosity studies were undertaken on a number of the clays. Results were not helpful in explaining the suspending characteristics previously observed.

From the experience gained in this work it was recommended that the official monographs be modified to include standards for arsenic, color, and viscosity of the bentonite.

Microfilm $4.20; Xerox $14.85. 326 pages.

HISTORY

HISTORY, GENERAL

AN EARLY IOWA COMMUNITY: ASPECTS OF ECONOMIC, SOCIAL AND POLITICAL DEVELOPMENT IN BURLINGTON, IOWA 1833-1866.

(L. C. Card No. Mic 61-1912)

George Albert Boeck, Ph.D.
State University of Iowa, 1961

Chairman: Professor Allan Bogue

This study traces the development of Burlington from its beginnings in 1833 through a generation of growth and concludes with the year 1866.

Part one examines the town in its territorial setting. As capital of the Wisconsin Territory and later of the Iowa Territory, Burlington became the focus of political life. After a period of uneasy neutrality, political parties evolved reluctantly, with local and territorial problems eclipsing national issues. By the end of the territorial period party lines were drawn and the apparatus of local political machinery established.

By the late 1830's the Iowa country evolved from a subsistence to an exporting economy and Burlington emerged as a growing mercantile center. The town possessed the conventional trades, crafts, businesses and professions, but lacked significant industries other than that of pork packing.

Winter was the "cultural season," and the citizens relied chiefly on local lecture series, lyceums, reading rooms, literary societies and social organizations for diversion. Community services, such as fire and police protection and public schooling, were virtually nonexistent. The incident of crimes and violence was negligible and a tradition of cooperative effort was quickly established; indeed, public matters were frequently determined extra-legally through the agency of the public meeting.

Part two examines a decade of progress following statehood. Merchandising and shipping remained dominant, but small industries added to the economy. The most dramatic developments came in the field of transportation as the town succumbed to a virulent "transportation fever." Burlington became the plank road leader of Iowa and the town subscribed in its corporate capacity to plank road companies. The same was true of railroads and the citizens went hundreds of thousands of dollars into debt to bring the Peoria and Oquawka railroad to Burlington and to build the Burlington and Missouri River railroad westward. An intense rivalry with other towns spurred this frantic investment which in later years resulted in repudiation and litigation.

The most striking aspect of political life was the importance of the foreign born population. Temperance and nativism often transcended national party issues. The foreign born constituted 26.5% of the total Burlington population in 1850. When the adult white males are considered separately, however, the foreign born total increases to forty per cent; this is not only a startling increase, but a more meaningful interpretation of census figures. The population structure of Burlington is examined in detail in terms of nativity and occupation.

The decade from 1857 to 1866 was one of depression and war. Lacking an industrial base, Burlington lost the ascendancy to other towns. Economic frustrations resulted in bitterness against railroad companies,

especially after local control over roads was surrendered to outside interests.

After an intense Know-Nothing interlude, the slavery question dominated politics and the parties in Burlington were subjected to the conventional stresses. The slavery controversy destroyed the Whigs, spawned Know-Nothingism, and led to a successful Republicanism.

The study closes with an examination of a generation of community leadership. A hard core of leadership emerged early and maintained itself for thirty years, although receptive to new additions always. The degree of opportunity is most impressive and the late nineteenth century Horatio Alger myth was an actuality in Burlington throughout these years. This, together with a sense of community purpose and of public responsibility, contrasts favorably with a rampant materialism and a lack of cultural achievements.

In conclusion it should be noted that Burlington and southeastern Iowa never experienced a "frontier process" in the Turnerian sense; indeed, the pioneers of Burlington were pioneers of a "bourgeois frontier" – a frontier which demands more study by historians.

Microfilm $6.30; Xerox $22.50. 496 pages.

THE DIPLOMATIC CAREER OF JOHN RANDOLPH CLAY

(L. C. Card No. Mic 61-2053)

George Irvin Oeste, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Roy F. Nichols

Orphaned son of a Philadelphia Congressman, named in honor of John Randolph of Roanoke, his father's political associate, John Randolph Clay (1808-1885) was raised and educated in Virginia under Randolph's guidance. He was admitted to the Virginia bar in 1828, but eventually diplomacy rather than the law became his life work. His diplomatic career of thirty years was the longest achieved by any individual prior to 1860. Its culmination was the period he served from 1847 to 1860, as representative of the United States to the Republic of Peru.

In 1830, John Randolph, appointed Minister to Russia by President Jackson, secured the appointment of Clay as his Secretary of Legation. After forty days at St. Petersburg, Randolph departed, seriously ill, leaving Clay as Chargé d'Affaires. Although youthful and inexperienced, Clay acquitted himself well. The chief business of Randolph's mission awaited the arrival of a new minister, James Buchanan, nearly a year later. Buchanan negotiated a treaty of commerce in December, 1832, which Clay delivered to Washington after an exciting journey across the frozen plains of northern Europe, and a stormy voyage across the Atlantic by packet ship.

Returning to Russia in 1833, Clay twice served as Chargé d'Affaires, after the return of Buchanan, and again following the resignation of William Wilkins. In 1837, Clay returned home. He had married, become a father, and found his salary inadequate to meet his new responsibilities. His brother urged him to enter business or practice law in Philadelphia.

The Panic of 1837, however, made business conditions so unfavorable that Clay determined to re-enter the diplomatic service. He was appointed Secretary of Legation in Austria, and was soon on his way to Vienna. Here he was involved in the strenuous effort of the State Department to convince the Austrian Government to give up its monopolistic restrictions on American tobacco. This project was carried on in almost every European capital; in Austria as elsewhere it was unsuccessful.

In 1845, Clay returned to Russia, still as Secretary of Legation. Two years later, he was appointed Chargé d'Affaires to Peru. He took up his duties in Lima in December, 1847.

In Peru, Clay proved to be an energetic representative of his country. He worked tirelessly and persistently, whether applying pressure for the payment of claims due under treaty provisions, protecting the interests of Americans who suffered injury or damages in political upheavals, or insisting on the rights of Americans to participate in the trade in guano. He successfully negotiated three treaties with Peru: dealing with commerce, maritime rights, and whaling. His greatest triumph was in avoiding an open rupture when the State Department blundered in declaring the Lobos Islands, which had always been Peruvian, open to American guano enterprisers. Shortly thereafter he was promoted to the rank of Minister Plenipotentiary. Success did not always crown his efforts. He was unable to induce Peru to abandon its system of guano consignments to British capitalists. He also failed in his efforts to open the upper reaches of the Amazon to world trade.

A controversy over two vessels seized by the Peruvian Government led in 1860 to a rupture of diplomatic relations. Clay, returning home after the Presidential election, found he would have no further opportunity to serve his country. He therefore took up residence in England, where he lived in retirement until his death in 1885.

Primary sources for the study include the diplomatic correspondence in the National Archives, a large number of letters of the Clay family preserved in private collections, and correspondence of Buchanan, Jackson, Randolph, and others in various libraries and repositories.

Microfilm $8.20; Xerox $29.25. 647 pages.

HISTORY, MEDIEVAL

PRESTER JOHN: THE LETTER AND THE LEGEND.

(L. C. Card No. Mic 60-3268)

Vsevolod Slessarev, Ph.D.
The University of Wisconsin, 1960

Supervisor: Professor Robert L. Reynolds

The Old-French prose versions of Prester John's letter differ from the Latin original in that they contain interpolations from the legend of St. Thomas' shrine which appeared first independently of the Letter. Even though it has always been recognized that the legends of Prester John

and St. Thomas were somehow related, no conclusive link between the two has been found so far.

The present study opens with a re-examination of the oldest sources reporting on St. Thomas and Prester John and it attempts to show how the two legends must have been created and transmitted by the Eastern Christians. Special attention is given here to the city of Edessa which must have played an important role in the contacts between East and West. A detailed analysis of the original Latin Letter leads to the conclusion that it was composed by a West European stationed in the Holy Land who came into contact there with Prester John's story which he then adorned with borrowings from the Alexandrian Romances and other medieval literature. The central part of the study is occupied by an introduction to the various French translations of the Letter, a facsimile reproduction of the French edition in the James Ford Bell Collection, University of Minnesota, and an English translation of its text. The dominant theme here is the beginning of the merger of the materials related to St. Thomas with those pertaining to Prester John. The concluding chapter is devoted to the medieval identifications of Prester John with various historical personalities and to the major modern interpretations of the origin of his name. On the basis of evidence drawn from the two legends and an entry in a Syriac martyrology it is possible to offer a new solution for the enigmatic title of the Indian king and priest which could have developed from a popularized version of the apocryphal Acts of St. Thomas. The Acts record a certain prince Vizan who was baptized and ordained by St. Thomas. In the Syrian church calendar he is called John. This finding makes it likely that the two legends belonged to the same cycle of stories created around the assumed Apostle of India. Microfilm $2.75; Xerox $7.00. 146 pages.

HISTORY, MODERN

THE INDIAN IN AMERICAN LITERATURE, 1680 TO 1760.

(L. C. Card No. Mic 61-2094)

Arthur Roy Buntin, Ph.D.
University of Washington, 1961

Chairman: Max Savelle

The Indian's presence was more of a living issue in the lives of a greater percentage of the people in the years prior to 1760 than in any other period of American history. To describe the emotions and patterns of experience communicated in literature born of this great Indian adventure is the goal of this study. Its purpose, also, is to demonstrate what works were available at a given point in time and to suggest that captivity narratives, historical and travel narratives, sermons and essays, verse, and printed Indian treaties may have helped shape or confirm the thoughts of literate colonials about their Indian neighbors. Characteristic of this study is its extensive sampling of contemporary thought--and its accompanying tone and idiom--through the quoted word. Only that which was published and thus made available to contemporary readers has been sampled for those neglected years, 1680 through 1760.

Structurally, this study is divided into four parts. Part I, "Indian Mancatchers and Masters," presents the viewpoints of female and male captives and second-hand interpretations of non-captives. The concept of an abusive and tormenting master overwhelms the minority report on the compassionate Indian. Part II, "The Indian of Historical Memory," demonstrates that colonials built images of seventeenth-century Indians and whites and that they admired the way in which earlier heroes had handled Indians. They, also, explained and described past Indian relations in the era of Anglo-French conflict. Part III, "The Contemporary Indian," presents anthropological speculations and observations and the responses of articulate patriots and partisans to the presence of the Indian threat, to Indian heathenism, and to the victorious years, 1759 and 1760. Part IV, "The Indian Speaks," describes the maneuvers and appeals employed by Indians and whites at the treaty conference in the service of self-interest.

The Indian example exerted power over literary imagination and shared a place in colonial thought patterns along with the Biblical story, the natural world, and the Old World literary heritage. Colonial writers used the Indian to justify and to document the ways of God to men and the ways of men to each other. Reverence to Indians proved useful in blasting reputations and in adding to heroic stature. Many writers associated French Catholicism with Indian warfare and thus strengthened and confirmed religious bigotry which was a part of the Old World heritage. Some writers showed awareness of the gap between Christian ideals and New World realities and continued and strengthened a tradition of self-criticism regarding the treatment of Indians.

Many individualistic and stereotyped images of Indians document three major concepts which appear in this monograph: the idea of menace by the children of Hell and of the Frenchmen; the concept of Nature's child, with its dual image of a man close to the level of the wild animal and of a noble, brave, and happy forest-dweller who was as capable as other men in reasoning and in rising to fulfill man's best potentialities; and the idea of cultural and racial difference with its corollary of white superiority and Indian inferiority.

In tone, colonials produced a militant literature which sought to arouse and to shock mind and body into action, into self-examination, into reformation. This literature enabled readers to project themselves into the shoes of the captive, the provincial negotiator, the Indian fighter, the missionary, the dying victim, and even of the Indian. It pictured brave colonials and Britons facing danger and tragedy to preserve Protestant civilization from the forces of barbarism and Catholicism. Truly, a sense of struggle and epic marked the literary record of Indian and white interaction in eighteenth-century America.

Microfilm $8.85; Xerox $31.50. 698 pages.

OPERATIONAL HISTORY OF THE LIVERPOOL & MANCHESTER RAILWAY, 1831-1845.

(L. C. Card No. Mic 60-6176)

Brother Lewis Donaghy F.S.C., Ph.D.
University of Pittsburgh, 1960

Operations on the Liverpool & Manchester Railway, which were begun on 16 September 1830, proved to be one of the most significant developments in transportation history. The progress of the Liverpool & Manchester after its opening until its consolidation with the Grand Junction Railway Company in 1845 effectively demonstrates that the L&M was truly the "Grand British Experimental railway." This evolution of the L&M, its growth, expansion and eventual consolidation, was typical of the majority of nineteenth century British railways, which had, in many instances, imitated L&M theory and practice.

Many histories of the L&M have been written, but of these only one, that of C. F. Dendy Marshall, covers the period of operations, growth and expansion, and Marshall's work is admittedly incomplete. In preparing this "Operational History," a detailed analysis has been made of the minutes of meetings of the L&M Board of Directors, the L&M Sub-Committee, the L&M Proprietors, special L&M committees, and other accounts and reports which comprise the records of the Company. In determining the expansion of the railway, the amending acts have been thoroughly explored as well as related sections of the Journals of the Houses of Commons and Lords. Contemporary newspapers such as the Liverpool Mercury, Manchester Guardian, the Liverpool Merchantile Gazette, and The (London) Times, have been used to get a broader view of L&M activities, and to delineate public opinion on many phases of L&M operations. Many graphic descriptions and detailed technological explanations were found in contemporary periodicals and journals such as Mechanics' Magazine, Herapath's Magazine, Gentlemen's Magazine, The Engineer, and The Railway Times. Recently published journals such as The Economic History Review, Railway World, Railway Age, Modern Transport, and The Engineering Journal, provided some very useful information. Finally, biographical accounts of important men connected with the L&M, such as George Stephenson, Robert Stephenson, Charles Vignoles, and Henry Booth, were used at great length.

Once the L&M started operations, the Directors strove constantly to meet demands for more adequate accommodations for merchants and passengers between Liverpool and Manchester. The ultimate of technological and financial efforts were expended in developing a safe, smooth and swift right of way. Rolling stock developed on the L&M was imitated throughout England as well as in Europe and America. The efforts to develop the best possible type of locomotive on the L&M were extraordinary, as is evidenced by the many experiments carried out by or in co-operation with the L&M on its own line. The impact of the railway on Lancashire is seen in the rapid development of trade and business in the two major cities of that county. As an investment, the L&M proved to be quite profitable as the London and Liverpool Share Markets between 1831 and 1845 readily testify. In many phases of operational activity such as rapid dispatch of hundreds of passengers at any one time, safety of operation, scheduling, signalling, ticketing, comfortable appointments both in coaches and stations, and providing special or excursion trains, the L&M became the prime example of British railways. Finally, the L&M provided the backbone for many branch lines, and the connecting link with London and southern England for its junction lines.

At the time of its amalgamation with the Grand Junction, the L&M was still expanding and, financially, in good condition. Thus its consolidation of interests can in no way be interpreted as a capitulation to a rival concern. Rather it was a case of the L&M Directors again demonstrating their foresight and good sense in recognizing that the interests of both the Proprietors and the public at large would be better served by such an action. The L&M was truly the prototype of the component parts of the British Railway System. It is in this sense that some have referred to the L&M as the progenitor of that great railway system. Microfilm $3.70; Xerox $13.05. 288 pages.

THE CHRISTIAN SOCIALISTS OF AUSTRIA AS A PARLIAMENTARY PARTY

(L. C. Card No. Mic 60-3578)

Edwin Lane Dunbaugh, Ph.D.
University of Pennsylvania, 1960

Supervisor: Dr. Otakar Odlozilik

The Christian Socialist Party was founded in 1887 to campaign in elections for the municipal government of the city of Vienna. The Vienna city council as well as the Austrian parliament was then dominated by the liberal parties, but this hegemony had been weakened by the economic crash of 1873 and the franchise extension of 1882. The Christian Socialist platform was geared to appeal to the newly enfranchised lower middle class of Vienna: moderate clericalism, moderate German nationalism and anti-Semitism, and moderate political and social reform. In its early years the Christian Socialists operated primarily in the Vienna city council and had only a negligible representation in the Austrian parliament. But in 1907 Austria adopted universal male suffrage, and, for the elections of that year, the Christian Socialist Party extended its activities to campaign throughout the German-speaking areas of the empire for seats in the Reichsrat. This study is an attempt to trace, analyse, and evaluate the Christian Socialists as a parliamentary party during the remaining years of the monarchy.

In 1907 it was widely believed that the introduction of universal suffrage indicated that Austria was embarking on a new era of government: the arbitrary absolutism was giving way to a constitutional monarchy with a representative parliament and a responsible ministry. In this light the Christian Socialists were anxious to secure as many seats as possible in the new Reichsrat. The election gave them the third largest mandate after the Czech Club and the Social Democrats. The Christian Socialists therefore merged with the Catholic Conservative Party to become the Largest party in the parliament. The two groups had little in common. The provincial party was agrarian and conservative while the Christian Socialists were urban and reformist. But these differences were significant mainly

for local issues. On the imperial level both were German, clerical, and loyal to the dynasty and to the empire.

As the leading party in the parliament the Christian Socialists received the presidency of the house and two seats in the cabinet. The party was prepared to take a leading role in Austria's constitutional experiment. But the performance of the Christian Socialists proved disappointing. In a subsequent election in 1911 the party lost many seats which indicated that in four years of power they had been unable either to forge a strong empire-wide organization or to hold the confidence of their constituents.

Much of the party's incapacity was the result of the type of government in which they served. The dissident ethnic and political groups in the house of deputies were unable to work together which rendered the parliament incapable of passing legislation. Thus the Reichsrat forfeited whatever authority the emperor might have been willing to grant it, and the sovereignty soon returned to the imperial bureaucracy. The Christian Socialist ministers, far from initiating policy, were often obliged to give their approval to government measures which were unpopular with the electorate. The conservative minority within the party, more influential in government circles than the older members, gained the upper hand which alienated much of the original urban following. With an ineffectual legislature there was little to sustain a parliamentary party. Consequently, the Christian Socialist organization tended to break down to its local components which revealed embarrassing cleavages among the party leaders.

Before the fall of the monarchy the Reichsrat itself succumbed to the war, and the Christian Socialist parliamentary party almost ceased to exist. The contribution of the party can perhaps best be measured by what followed, for the organization which was forged in the last years of the empire, though largely ineffective at the time, provided the nucleus for the powerful Christian Socialist Party of the Austrian Republic.

Microfilm $3.80; Xerox $13.30. 294 pages.

PROHIBITION AND POLITICS IN TENNESSEE, 1885-1920.

(L. C. Card No. Mic 61-1365)

Paul Edward Isaac, Ph.D.
The University of Texas, 1961

Supervisor: Barnes F. Lathrop

Prohibition in Tennessee was achieved gradually by means of a series of legislative enactments known as the Four Mile Laws. The first, passed in 1877, forbade the retailing of intoxicants within four miles of incorporated rural schools. The second, in 1887, extended prohibition to the area around any school building outside an incorporated town, thus practically outlawing the sale of liquor in all of rural Tennessee. A vigorous attempt to secure state-wide prohibition through a constitutional amendment failed in 1887, but in 1899, 1903, and 1907 additional Four Mile Laws were passed enabling incorporated towns to come under the ban on liquor sales so that by 1908 saloons had been closed in nearly all the towns in Tennessee except Memphis, Chattanooga, Nashville, and La Follette.

Determined to destroy the liquor traffic completely, Tennessee prohibitionists led by the Anti-Saloon League launched in 1908 a drive for state-wide prohibition that led to the disruption of the Democratic Party. In the gubernatorial primary Ex-Senator Edward Ward Carmack championed the prohibitionist cause but failed to defeat the incumbent, Malcolm R. Patterson, who defended local option. Then in November two close political allies of Governor Patterson killed Carmack in a gunbattle in downtown Nashville and provided the temperance crusaders with a martyr-hero. In the legislature of 1909 prohibitionist Democrats joined the Republicans, who had already accepted prohibition, to enact laws forbidding the manufacture and sale of intoxicants anywhere in Tennessee. In 1910 prohibitionists and others who opposed Patterson organized the Independent Democratic movement and formed a coalition with the Republicans to elect Ben W. Hooper, a Republican and prohibitionist, governor. Though some of the Independents rejoined the Democratic Party after Patterson lost control of it, a large bloc of them remained allied with the Republicans until the Democratic Party finally endorsed prohibition in 1914.

Attempts at state-wide prohibition in Tennessee produced a crisis in the field of law enforcement. Opposition to prohibition by a majority of the people in Memphis, Nashville, and Chattanooga led officials in those cities to allow the open sale of liquor in spite of the law. The state, lacking a police force and having little authority to interfere in local affairs, found itself almost helpless. After a bitter and prolonged struggle Governor Hooper finally secured in 1913 a nuisance abatement act which authorized the closing of saloons by civil action instituted by either citizens or officials. This act resulted in the temporary closing of a large number of saloons, but city police refused to keep them closed. Only after the passage in 1915 of a law providing for removal of derelict officials by the courts did municipal authorities undertake seriously to enforce prohibition. Two years later a "Bone Dry" law outlawed the transportation of any liquor into Tennessee, yet the act was violated repeatedly, and bootlegging flourished even after state legislation was reinforced by national prohibition.

Microfilm $5.95; Xerox $21.20. 467 pages.

THE IMPACT OF THE GREAT DEPRESSION ON THE ARMY, 1929-1936.

(L. C. Card No. Mic 60-6296)

John William Killigrew, Ph.D.
Indiana University, 1960

With the onset of the depression the Army accepted the fact that it would have to curtail and defer many of its activities in order to stabilize the military budget at approximately $350,000,000 annually. The Army was willing to sacrifice any activity except those that were related to manpower and training; it was the basic belief of the General Staff that the maintenance of the trained manpower

reserve of the nation was essential. As a result the policy of the Army was to emphasize manpower rather than weapons and material programs. This caused the exacerbation of relations between the air power advocates and the conservative and tradition-minded General Staff.

The advent of the Roosevelt Administration and the New Deal brought reduction of military expenditures to such a low level that the Army believed national security was endangered. This was the cause of mistrust and suspicion between the Army and the Administration. At the same time the Army was called upon to administer the Civilian Conservation Corps (CCC). The use of Regular Army officers for this task seriously lowered the efficiency of the standing army and hampered the training of the civilian components. Over a period of time the Army sought to replace regular officers with reservists. The Army was unenthusiastic about participating in the CCC and except for one isolated incident it did not seek to integrate the CCC into the formal structure of the military establishment. By 1936 the Army informed the Administration that it wanted to be relieved of further participation in the CCC.

During the Roosevelt Administration the Army sought to obtain public works funds to procure new equipment, in particular new artillery, armored vehicles, and aircraft. In 1933, and again in 1935, General Douglas MacArthur presented to the Administration detailed plans for the use of public works funds for mechanization and modernization of the Army. The Army claimed unsuccessfully that the use of public works funds for this purpose would simultaneously alleviate unemployment and benefit national defense.

In 1935 and in 1936 Congress increased military expenditures well over the amount that had been submitted by the Administration. The main issue at this time was the increase in the strength of the Regular Army from 118,000 to 165,000 enlisted men. The Army claimed that this latter figure was the minimum standing force that could provide for the adequate defense of the nation while mobilization plans were being put into effect and the mass citizen army was being formed. Twice the Roosevelt Administration refused to approve this increment. Congress disregarded the Administration and incorporated funds for the increase of personnel in the annual appropriation bill.

By 1935 the Army began to realize that its mobilization plans, which called for the mobilization of some one million men within ninety days after the declaration of an emergency, were unrealistic. It was believed that a force of that size could not be adequately supplied with its war reserve of equipment through any possible peacetime appropriation. The Army revised its 1933 mobilization plan and based the new plan on a moderate size force that it hoped could be equipped through peacetime procurement. Thus military policy and plans were the result of fiscal developments.

The policy of the Army toward its Research and Development (R&D) program began to be altered in 1935. This was caused by the fact that funds were not sufficient to provide for a viable R&D program and at the same time provide for the procurement of new equipment. The previous policy had emphasized the maintenance of a small R&D program so that in time of emergency pilot models of various items could be mass produced by American industry for the mobilized army. Because of the prohibitive cost no effort was made to keep the Army equipped with the latest type of equipment. By 1936 this policy was changed and R&D was curtailed and priority was given to placing in the hands of the troops the latest equipment available.

The official Army records in the National Archives building in Washington and the World War II Records Center in Alexandria, Virginia, were used extensively for source material. During the preparation of this paper the author had an appointment as Associate in Military History at the Office of the Chief of Military History, Department of the Army. Microfilm $5.85; Xerox $20.75. 458 pages.

CZECH NATIONALISM: A STUDY OF THE NATIONAL THEATRE MOVEMENT, 1845-1883.

(L. C. Card No. Mic 61-1408)

Stanley Buchholz Kimball, Ph.D.
Columbia University, 1961

This dissertation attempts a full treatment of the history of the movement to construct the Czech National Theatre, and the relation of the movement to Czech nationalism in general, throughout most of the latter part of the nineteenth century. The study is based primarily on documents which were found in various archives in Prague and Vienna, supplemented by memoirs, biographies, and a survey of the contemporary daily and periodical press.

Czech nationalism was probably the most important, fully developed, and representative example of East Central European nationalism and deserves to be studied more than it has been. The subject around which this study revolves, the National Theatre itself, assumed many roles as a monument, agent, symbol, manifestation, symptom, and cause of nationalism and rebirth. It is the thesis of this study that the movement to construct the National Theatre is one of the best single examples of the origin, growth, and development of the Czech national "re-awakening" from the misty origins in the late eighteenth century to full maturity a century later. On several occasions the National Theatre movement also contributed to the growth of Pan or all-Slavism. Two great national celebrations connected with the National Theatre, the laying of the foundation-stone in 1868 and the opening of the theatre, in 1883, became important all-Slavic events.

The men who built the Czech National Theatre sought to achieve two things: to build a theatre suitable for the production of Czech dramas, and, of much greater significance, to promote national consciousness. This dissertation deals primarily with the latter objective, the study of which provided an excellent opportunity to examine closely the process of a loosely organized and nationally indifferent people becoming nationally self-conscious, and the procedure by which patriots communicated with, propagandized, and nationally awoke the masses.

The movement extended over forty years and its presentation is necessarily involved. There are many issues, two generations of patriots, and internal and external conflicts. It is offered as a microcosm of the whole phenomenon of a national "re-awakening."

A chapter by chapter description furnishes the best

summary of the study's substance. The first chapter presents the "inevitable background"--a survey of Czech theatre to 1848. Chapters two and three treat the organization of the Committee to Build the National Theatre shortly after the disappointments of 1848-1849, and the attempts of the Committee (the most important national organization of the bleak 1850's) to go to the people for support, and to create an antidote to the failure of 1848 and subsequent Viennese absolutism.

Chapter four examines the reasons behind the failure of the Committee to build the National Theatre or successfully to promote national consciousness during the 1850's, and carries the story through the more successful 1860's when construction of the National Theatre was actually begun. Chapters five and six form a unit within themselves. These chapters present a very detailed description, analysis, and evaluation of one of the most important national and all-Slavic celebrations in East Central Europe during the nineteenth century. Chapter five tells the full story of the celebration at the time of the laying of the foundation-stone, May 1868. Chapter six presents and analyzes the participation in, and reaction to, the celebration of the Czechs themselves, other Slavs, and the Germans, and compares the celebration with the Slavic Congress of 1848 and the Moscow Ethnographic Congress of 1867.

Chapter seven has three main divisions: the disappointing aftermath to the success of 1868, the "Old" and "Young" Czech political feud of the 1870's and its relation to the National Theatre movement, and the first completion of the National Theatre in 1881. The final chapter tells of the "Second Sacrifice" (the rebuilding of the theatre after its accidental destruction by fire in 1881), and of another national and all-Slavic celebration incident to the reopening of the National Theatre in 1883.

An epilogue relates the movement to build the National Theatre with the success of the National Theatre as a producing institution following its completion in 1883.

Microfilm $3.35; Xerox $11.70. 260 pages.

THE VIOLENT VOLUNTEERS: A HISTORY OF THE VOLUNTEER FIRE DEPARTMENT OF PHILADELPHIA, 1736-1871.

(L. C. Card No. Mic 60-3676)

Andrew H. Neilly, Ph.D.
University of Pennsylvania, 1960

Supervisor: T. C. Cochran

INTRODUCTION

The period in which the volunteers flourished was a time of political and economic excitement. The Jacksonian revolution gave it direction and inspiration.

I. Philadelphia's rapid growth forced the attention of leading citizens on fire protection. Their concern found expression in magazine articles and eventually led to the organization by Benjamin Franklin (1736) of the first fire company in America.

II. Philadelphia's early provision for using Schuylkill water gave this city an advantage in fire-fighting. Hose companies sprang up in profusion and added to the social problems of the city.

III. The growth of violence became acute. Every company felt this pressure and tried in vain to regulate the behavior of their own members by strict regulations.

IV. By the Thirties, fire companies had solidified their position as a part of the city's life; a powerful social force. Violence became an expression of this power drive. Anti-Negro demonstrations swept the city.

V. The crescendo of violence increased during the Forties, reaching its peak in the Nativist riots of 1844. Efforts to curb the firemen failed to reach the heart of the trouble.

VI. The Fifties brought a complete change in the fireman's life. Steam engines arrived and won their dominance. Consolidation arrived in 1854 and resulted in an organized municipal department (1855).

VII. Violence decreased when the Civil War began. Firemen enlisted in large numbers and performed heroically. Care of the wounded occupied attention. Hibernia Fire Engine Company went to Fortress Monroe and Washington. Ambulances for transportation of wounded did good work.

VIII. Firemen loved to parade. In 1832, they celebrated the 100th Anniversary of Washington's birthday. After that, marching in "equipments" became a passion.

IX. Firehouses developed in the second and third decades until they became fraternity houses. Soon they attracted the rougher element with time on their hands. "Bunkers" became residents of the houses. On occasions, the members used the houses as fortresses equipped with weapons. Balls and annual dinners with songs helped to unite the firemen.

X. "Visiting Firemen" are words that belong together. As soon as transportation became tolerable, the custom of visiting firemen in other cities and entertaining firemen from distant points, grew quickly until it became a passion. In the Fifties and Sixties, elaborate preparations, sumptuous entertainment, and the necessarily wasted time became a source of irritation to the ordinary citizen. Two famous visits are here recorded. When the volunteer system ended, the visiting fireman disappeared.

XI. When the Temperance movement swept the country, in the Forties, the firemen showed interest. Many signed the pledge. The revival of '57 made a deep impression.

XII. Large conflagrations, such as devasted New York repeatedly, were unknown in Philadelphia. Some fires took place which caused considerable damage. Explosives and coal oil presented threats.

XIII. After the war, the firemen resumed business. The passion to run the department without control increased. The reformers pushed a paid department. Against fierce opposition, the movement for a change persisted. In December 1870, the Mayor's pen ended the volunteer system.

XIV. This is a summary of the history with an attempt at evaluation.

Microfilm $3.10; Xerox $10.80. 237 pages.

THE COMMITTEE FOR COMPOUNDING WITH DELINQUENTS 1643-1654: A STUDY OF PARLIAMENTARY FINANCE DURING THE ENGLISH CIVIL WARS.

(L. C. Card No. Mic 61-1660)

James Ward Pringle, Ph.D.
University of Illinois, 1961

One of the most powerful financial agencies created by the Parliament during the rebellion of the seventeenth century was the Committee for Compounding with Delinquents. This study traces the origins and development of this influential group, examines the nature and functioning of the Committee's operations, and attempts to assess the effect of the Committee's activities on both the parliamentary finances and on the royalists.

Compounding with delinquents permitted royalists to redeem their sequestered properties by paying a monetary fine proportionate to the value of the estate. These fines served a double purpose; they brought substantial sums into the parliamentary coffers while simultaneously weakening the financial strength of the King's followers. This dual advantage made the work of the Committee for Compounding uniquely valuable within the fiscal organization of the Houses.

In this study, consideration is first given to the formation of the parliamentary financial system. Voluntary and forced loans, property assessments, sequestration of lands and goods were among the more prominent measures which the Parliament adopted in the early months of the war to satisfy its fiscal needs. Various committees were established to gather and distribute these and other revenues. The arrangements were tentative and makeshift, and there was considerable waste and inefficiency in these early days of the struggle.

Compounding with delinquents came rather late upon the parliamentary financial scene. At the London Goldsmiths' Hall a Committee for Scottish Affairs had been formed in 1643 to supply funds for the Parliament's Scottish allies. This Committee resorted to a variety of financial devices in order to meet its obligations. One of the techniques this group employed was compounding with delinquents. So lucrative and satisfactory did compounding prove that soon the Committee for Scottish Affairs began to devote most of its attention to that operation. Before long, the group at Goldsmiths' Hall became known as the Committee for Compounding in recognition of what was now its chief function. In tracing this transformation, the study takes note of the men who constituted the Committee and the changing conduct of their work.

By 1646 the Committee for Compounding had reached the heights of its powers. The third chapter of this study examines the Committee's career during that year. The effect of compounding on the delinquents, the modifications and improvements in the Committee's rules and procedures, and the group's contribution to the parliamentary war effort are among the topics surveyed.

The Committee's vicissitudes during the next seven years are treated in the subsequent chapters. Especially noted is the Committee's assumption of the management of sequestered royalists estates, an added activity which greatly broadened the group's influence and multiplied its labors. This administration of sequestered properties gave the Committee at Goldsmiths' Hall direct supervision over the local county committees.

A large portion of Chapters V and VI is concerned with the Committee's efforts to put sequestration and compounding practices on a more efficient and productive footing. Also considered are the several re-organizations which the Committee underwent for political reasons or administrative improvement. In the final chapter an effort is made to draw up an accounting of the Committee's revenues and disbursements, and relate these figures to the parliamentary financial results as a whole.

One general conclusion emerges from this study: that the parliamentary financial organization improved in nearly every aspect as the struggle progressed, and that the superior financial system which the Houses developed was a major factor in bringing about the defeat of the Stuarts. The men of Westminster raised unprecedented sums from a static economy by energetic utilization of whatever resource or technique came to hand. Eventually, just as the royal forces could no longer combat the parliamentary armies, so the royal exchequer could not compare with the parliamentary treasury. By carrying on compounding with the delinquents for over a decade, the Committee at Goldsmiths' Hall played a vital role in neutralizing the royalists and in contributing to the parliamentary treasury, so that victory might be won.

The materials for this study were drawn principally from three printed sources: the Journals of the House of Commons, the Calendar of State Papers, Domestic, and above all, the Calendar of the Committee for Compounding edited by Mary Anne Everett Green. The latter consists of five thick quarto volumes in which a mass of essential data on the Committee's functions has been collected. Without this excellent Calendar, research on the Committee's operations would have been infinitely more difficult. In addition to these basic sources, information was also found in the several works of Samuel Rawson Gardiner and Charles Harding Firth. Other standard histories of the period were also consulted, and these were augmented by the special studies of Margaret James, Christopher Hill, Sidney Madge, John Sinclair, John Stevens as well as many others. Microfilm $3.65; Xerox 12.85. 282 pages.

LUCIUS LYON: HIS PLACE IN MICHIGAN HISTORY.

(L. C. Card No. Mic 61-1786)

John Shirigian, Ph.D.
University of Michigan, 1961

The purpose of this study is to show the nature and importance of Lyon's contributions to the economic and political development of Michigan.

A brief introductory chapter considers Lyon's Vermont background and his early years in Michigan following his arrival in Detroit in 1822 at the age of twenty-two. Chapters two and three are concerned mainly with Lyon's work as a deputy-surveyor in Michigan Territory and adjacent areas during the years 1823-1833, and with his activities as a land promoter and land speculator up to the depression of 1837. The fourth, fifth and sixth chapters

deal with his political career from 1833 to 1839, when he served as Michigan territorial delegate in Congress, as a member of the Michigan constitutional convention of 1835, and as one of the first two United States senators from Michigan.

Chapters seven and eight give an account of Lyon's work as a special Indian commissioner in Wisconsin in 1839 and of his business ventures in the 1840's--his salt-drilling operations at Grand Rapids, and his experiments with a harvesting machine and with sugar beet production. The ninth and tenth chapters recount his work during his single term in the lower house of Congress from 1843 to 1845, and his activities as surveyor-general of Ohio, Indiana and Michigan in the years 1845-1850. Chapter eleven is concerned with Lyon's conversion to Swedenborgianism in 1846 and his subsequent activities as a member of that sect. A final chapter presents a summary and conclusion.

Lyon's work as a deputy-surveyor carried him through thousands of miles of Michigan Territory and made him extremely well-informed about that huge area of land. The knowledge thus gained was put to good use by him in acquiring choice lands during his land promotion activities in the late twenties and early thirties. Especially noteworthy in this connection were his contributions to the early settlement of the Grand River and Kalamazoo valleys of Michigan, particularly with respect to the towns of Grand Rapids, Ada, Lyons, Kalamazoo and Schoolcraft. His promotion schemes came to a swift end, however, with the onset of the depression in 1837, and the resultant sharp drop in land prices wiped out most of his holdings. His attempts at economic recovery in the forties, particularly by means of salt production at Grand Rapids, ended in failure, and his last years still found him, struggling to rid himself of debt.

Lyon's terms as territorial delegate and United States Senator came during Michigan's transition from territory to statehood. Lyon became engaged in the struggle to achieve statehood without losing the area along Michigan's southern border which was being claimed by Ohio. The struggle proved futile, but Congress compensated Michigan for its loss by awarding it a part of the peninsula lying between Lake Michigan and Lake Superior.

While serving his single term in the national house of representatives in the forties, Lyon emerged as one of the strongest supporters of Lewis Cass for the Democratic presidential nomination in 1844. His efforts were of no avail, however, for the convention nominated James K. Polk, a dark horse candidate from Tennessee.

During Lyon's term as surveyor-general the work of the Ohio and Indiana surveys was completed, and substantial progress was made on the surveys in Michigan. Lyon was a strong advocate of Douglass Houghton's idea of combined linear and geological surveys, and he attempted to continue Houghton's work in the Upper Peninsula after the latter's death in 1845. He was only moderately successful, however.

Lyon's conversion to Swedenborgianism in 1846 brought a large measure of peace and tranquility to his final years. He died in 1851.

Microfilm $3.25; Xerox $11.50. 251 pages.

THE IRRECONCILABLES AND THE FIGHT AGAINST THE LEAGUE OF NATIONS

(L. C. Card No. Mic 61-1670)

Ralph Allen Stone, Ph.D.
University of Illinois, 1961

The fight in the United States Senate against the League of Nations constitutes an exciting and significant chapter in American history. This study focuses on what was certainly the most colorful and in some ways the most significant group of Senators to take part in that fight. Denounced and villified at the time, the irreconcilables have remained a surprisingly obscure and to some degree misunderstood body of men. Upon such an elemental question as their number, there has been wide disagreement. The purpose of the study is to define their membership, analyze their ideas, and evaluate their role in defeating the League of Nations.

The irreconcilables were those Senators who voted against, or had it announced they would have voted against, the Treaty of Versailles on the four separate occasions when it came to a vote. There are fifteen Senators who so cast their votes: William E. Borah of Idaho, Frank B. Brandegee of Connecticut, Albert B. Fall of New Mexico, Bert M. Fernald of Maine, Joseph I. France of Maryland, Asle J. Gronna of North Dakota, Hiram W. Johnson of California, Philander C. Knox of Pennsylvania, George H. Moses of New Hampshire, George W. Norris of Nebraska, Miles Poindexter of Washington, James A. Reed of Missouri, and Lawrence Y. Sherman of Illinois. Fourteen of the fifteen were Republicans; James Reed was the only Democrat.

A critical examination of their speeches and statements on foreign affairs from 1914 to 1918 reveals a heterogeneous group of individuals whose thinking greatly differed on such questions as preparedness, the causes of and entry into World War I, and the proper means to preserve peace. Their differences at this time foretold their later disagreements on the League itself. Biographical sketches, emphasizing the personal, political, and economic factors which helped determine their position have been made. Within the group were men whose oratorical abilities, parliamentary skills, and political independence especially qualified them to oppose the League.

The major portion of the work falls within the period from October, 1918, to March, 1920. The irreconcilables seized the initiative during the early months of the League fight, and put the League proponents on the defensive. This resulted not only from their being in the role of critics rather than defenders, but also from their cooperating in parliamentary tactics, their ability in give-and-take debate, their willingness to expend greater physical effort, and the penetration of their arguments. Throughout the contest they waged a determined and intelligent campaign. Recognizing the danger of sudden action by the Senate, they adopted various delaying measures. Their significant part in devising the Round-Robin, their filibuster ending the sixty-fifth Congress, their organization of an anti-League propaganda group, and their securing of financial backing were acts which contributed to their final victory.

The irreconcilables could not have achieved defeat of the League without the assistance of Henry Cabot Lodge and Woodrow Wilson. Realizing this fact, they acted so as

to take advantage of it. Their cooperating with Lodge in voting on reservations to the Treaty but voting against the Treaty with these reservations illustrated a political astuteness lacked by the President. Cognizant of Lodge's political motivations, they frequently forced him to accept their views by threatening to bolt the party.

Their criticisms of the League, while often irrelevant and demagogical, exhibited an understanding of the weaknesses of collective security. They also suggested alternatives to the League, which partly answered charges that their role was solely negative.

Microfilm $3.95; Xerox $13.75. 305 pages.

INDEPENDENT SYRIA, 1946-54.

(L. C. Card No. Mic 61-1800)

Gordon Howard Torrey, Ph.D.
University of Michigan, 1961

This is a study of the Syrian political scene from the end of World War II until the fall of the Shishakli dictatorship in early 1954. The forces at play which determined the course of history in the Syrian Republic are emphasized and analyzed. The main theme is the duality and rivalry between the civilian and military leadership of the country during this period.

While this work is intended primarily to be a history, of necessity considerable emphasis has been given to the forces which influenced Syrian politics during the years 1945-54. Therefore, the first section deals with the background necessary for a fuller understanding of the second section, which is the narrative. Included in the first section are a geographical description of the country, a discussion of the Syrian people--their religions and national groupings--, a historical resumê up to 1945, an analysis of the social, cultural, and economic factors which affected Syrian political life, and a description and historical explanation of the structure of the government, legal system, and press.

The main body of the work opens with a description of the political and economic situation prevailing in Syria at the end of World War II. The first turbulent years of the republic are reviewed and the consequences of participation in the Palestine War of 1948 are dealt with at length. The circumstances of the first military coup are explained, as well as subsequent interventions by the military. The narrative concludes with an account of the overthrow of the Shishakli military dictatorship and the brief return to civilian government in 1954.

The conclusion concerns itself with the factors which brought about the failure of democratic republican government in Syria. Basically, this failure stemmed from a lack of national cohesiveness on the part of the Syrian people, a dearth of statesmen, an unfortunate geographical position, and the inheriting of an alien political system. This combination of factors continually plagued the Syrian Republic and, in the end, brought about its demise.

Microfilm $3.85; Xerox $13.50. 297 pages.

THE COMMUNE IN FRENCH HISTORICAL WRITING

(L. C. Card No. Mic 61-1683)

Stanley Martin Yates, Ph.D.
University of Illinois, 1961

This survey of the Paris Commune of 1871 begins with nine Communard authors whose writings reflected the contending ideologies of the First International. Set against the Proudhonist idea of local autonomy and the national federation of communes was the desire by some Communards to collectivize the land and means of production. Some also described the struggle between the Commune and the government in class terms. These writings also showed the deep division in the Commune between advocates of a centralized or decentralized government.

Contemporary anti-Communards included moderate republicans who were generally critical both of the Commune and the royalist dominated National Assembly. Two clergymen, Catholic and Protestant, tried to impute the reasons for the faults of the Commune to the defects of the other's religion. Another writer, Maxime Du Camp, most strongly represented a common tendency among the conservatives of describing the horrors of the Commune as the result of the unrestrained action of the evil inherent in man.

Another group of contemporaries was the three writers who wanted an amnesty for the Communards still in prison. They were all republicans who based their appeals on the need for strengthening the republic by closing the gaps among the republicans and by forgetting the rancors and bitterness caused by the Commune and by the government's repression of it.

Among the non-contemporary writers are monarchists who believed that the defeat of the Commune saved the republic by assuring a stable, conservative constitution. A doctor regarded the Commune as a neurotic outburst of the Parisian mobs. Still another writer, limiting himself to the field of justice, concludes that none of the Communard reforms were either new or lasting.

Those non-contemporaries favorable to the Commune include one who attempts, with existentialist overtones, to construct a theory of revolution based on an examination of the causes of the Commune. As for the Socialists, some see the mere existence of the Commune as its great significance and, like the Communists, believe the economic condition of France was the eventual cause of its defeat. But they also criticize the Commune for failing to realize that it was a social and not a political revolution.

The Communists consider the failings of the Commune as lessons for Marxist revolutionaries. They particularly note the absence of a proletarian, revolutionary party which could have led the workers to victory. This is traced to the absence of class consciousness among the workers. The Commune is also regarded as the first example of true democracy, since it represented the majority of the people--the exploited. Therefore, it was the prototype of the Russian soviets and its democracy has pointed the way to the democracies of Russia and the People's Democracies.

Two conclusions are derived from this study. The first is the need for a comprehensive outlook by the historian in evaluating the role of the individual in history.

The Commune offers a chance to study this point because long-range forces are contrasted against the personal decision of Thiers and because of the wide variety of interpretations of the Commune.

The second arises from these varied interpretations. Can anyone of them be regarded as objective and superior to the others? There are three levels of judgment: the use of facts to support a thesis, the underlying general attitude or philosophy of history, and the style and manner of writing. It is concluded that as long as relevant material is neither suppressed or distorted, any interpretation can be objective and superior. Most of the confusion and disagreement occurs on the second level of judgment.

Microfilm $4.70; Xerox $16.65. 366 pages.

HOME ECONOMICS

SOCIAL AND PSYCHOLOGICAL FACTORS ASSOCIATED WITH HIGH-SCHOOL MARRIAGES

(L. C. Card No. Mic 60-6377)

Raquel Marzan Inselberg, Ph.D.
The Ohio State University, 1960

An experimental group consisting of couples among whom at least one of the spouses was under nineteen years of age and attending high school at the time of marriage was compared with a control group, made up of couples marrying between twenty-one and twenty-six years of age, with respect to selected "background" and "marital" characteristics.

A total of 40 couples and 18 additional wives whose husbands could not participate formed the experimental group, while 40 couples and 11 wives comprised the control group. All respondents were white, native-born Americans, residents of Metropolitan Columbus, Ohio, and had been married between three and thirty-six months. The husbands in both groups were mainly skilled craftsmen and semiskilled or unskilled laborers. The bivariate frequency distribution with respect to length of marriage and husbands' occupational ratings (as measured by the North-Hatt Scale) in the experimental group was approximated in the control group. Husbands and wives were interviewed separately.

Differences were noted between the experimental and control groups in some "background characteristics": (1) Husbands in the experimental group were less likely to come from "intact" families; (2) the younger wives reported greater disagreement with their parents before marriage; (3) a lesser degree of attachment to the father was indicated by the experimental group; (4) young age at the time of the first date and steady dating experience were more characteristic of the experimental group; (5) the frequency of premarital pregnancy was greater for the experimental group by a factor of four; and (6) couples in the control group had a longer period of premarital acquaintance and of engagement.

Background characteristics in which no differences were found between the two groups included (1) the degree of happiness experienced in childhood; (2) the perceived marital happiness of parents at the time of the respondents' marriage; (3) the length of steady dating; and (4) the anticipated departure of a serviceman for overseas duty.

The two groups differed in most of the selected marital characteristics studied. Thus, (1) parental disapproval of the marriage at the beginning was more characteristic of the experimental group; (2) the mean income of the experimental families was considerably smaller; (3) living with others was a more common occurrence in the experimental group; (4) greater percentages of wives and husbands in the experimental group indicated a lack of readiness for marriage; (5) in-laws were more often an area of conflict among the younger wives; and (6) there were strong indications that the respondents in the experimental group were less satisfied with marriage, on the basis of over-all satisfaction ratings, using a marital satisfaction scale and a sentence completion blank.

Some marital characteristics in which differences between the two groups could not be detected were (1) the reported proportion of premarital friends retained; (2) the number of "things" missed because of marriage; (3) the extent of satisfaction with income; and (4) the reported degree of marital happiness.

On the basis of the findings, it would appear desirable to begin instruction on courtship and marriage no later than the ninth grade. Use of the family-centered approach in home economics could result in more adequate preparation for marriage.

Microfilm $2.75; Xerox $7.00. 150 pages.

THE PREPARATION AND EVALUATION OF A RESOURCE UNIT ON CHILD DEVELOPMENT

(L. C. Card No. Mic 61-525)

Mary Eloise Stone, Ed.D.
Syracuse University, 1960

The purpose of this study was to prepare and evaluate a Resource Unit on Child Development in home economics curriculum, specifically adapted for the general learning ability of pupils within the seventh or eighth grade who have had no special study in child development. It was made in three parts: 1) preparation of the Resource Unit at three learning levels: rapid, average, and slow; 2) the experimental use of the Resource Unit; and 3) evaluation by 94 pupils (38 rapid learners, 44 average learners, and 12 slow learners) and the 8 teachers who used these materials.

The Resource Unit included the following: 1) Teacher's Guide and accompanying motivation materials; 2) individual materials for each pupil: "Our Small Friends" (reading materials developed for three learning ability levels), set of Child Care Booklets, and an evaluation device or game; and 3) evaluation materials: objective test, questionnaire, attitude scale, and evaluation sheet.

Following the pilot study an experiment was carried on involving 223 pupils of 6 teachers from 4 New York State school systems. Each teacher taught a unit on child development to one or more sets of two classes. The experimental class used the Resource Unit on Child Development For the control class the teacher used her best previous method in a course approved by the New York State Education Department. Both groups were administered a criterion test, a questionnaire, and an attitude scale at the beginning and at the end. In addition, the experimental group completed an evaluation sheet after their study. Complete data were received from 178 pupils of 5 teachers from 3 school systems: 94 experimental pupils (38 rapid learners, 44 average, and 12 slow) and 84 control pupils (49 rapid, 29 average, and 6 slow). The teachers responded to an evaluation questionnaire.

The following general conclusions appear justified from this study:

In comparing the mean differences between initial and final scores of the criterion test with a t-test, no significant difference was found between the experimental and control groups, between rapid learners from these groups, between average learners, or between slow learners. However, significant t's were found ($p < .01$) when matched pre-test and post-test scores of each group were compared.

Much experience with care of children was reported initially. This appeared to increase slightly over the three-week period. Experimental pupils reported most increase in feeding and reading to children. Control pupils also reported greatest increase in reading. Both groups reported a decrease in number of problems after study; the number of questions each group listed increased.

Attitudes appeared predominantly favorable and neutral in the beginning with some change reported. Much of this shift was in the favorable direction but some increase in "dislike" by experimental pupils suggests need for finding satisfaction from all aspects of children's care.

Data from the criterion test, the experience questionnaire, and the attitude scale appear to indicate the need for further child development study.

Pupils' interest in each of the three approaches was high. Pupils at each level learned from each approach and made suggestions for a future unit. Teachers need to demonstrate frequently and to place increased emphasis on obtaining pupils' generalizations from experiences selected from the Resource Unit.

Teachers found the Resource Unit on Child Development provided ongoing fluid curriculum materials which they could use with rapid, average, and slow learning pupils. Use of multi-level materials stimulated each ability level with little pupil awareness of differences.

Microfilm $5.75; Xerox $20.30. 449 pages.

ORIGINAL AND CHANGED ATTITUDES, IMPRESSIONS, AND PRECONCEPTIONS AS RELATED TO THE MASS MEDIA EXPERIENCES OF NEW FOREIGN STUDENTS AT THE STATE UNIVERSITY OF IOWA.

(L. C. Card No. Mic 61-1916)

Horace Greeley Dawson Jr., Ph.D.
State University of Iowa, 1961

Chairman: Professor William E. Porter

Several recent studies among foreign subjects in the United States have attacked problems of especial interest to students of education and the social sciences. The present one, conducted among 62 first year foreign students at the State University of Iowa, was undertaken as a pilot study in the area of mass communication.

It was an investigation of the attitudes, impressions, and preconceptions of the students regarding the United States and Americans and the possible relation of these to experiences with the American mass media of communication in home countries. The four principal areas of concentration were (1) family relations, (2) standard of living, (3) economic, political, and social outlook, and (4) college life.

Basic assumptions guiding the study were:

1. Upon entering the United States, the foreign students possess ascertainable attitudes toward and images of the United States and Americans.
2. These images are culture-bound and will, in general outline, reflect the subjects' identification with reference groups.
3. The preconceptions of these students are probably derived in large measure from their exposure to American books, films, magazines, newspapers, radio, and television in home countries.
4. Personal Experiences in the United States over a period of time will effect significant modification in the subjects' preconceptions.

THE METHOD

The technique employed involved the use of open-end and multiple-choice questions, a word-list, and an attitude scale. These were administered to the 62 subjects in personal interviews at the beginning of the 1959-60 school year, followed by a group interview along the same lines toward the end of that school year. The data were analyzed to define the image or images of the United States and Americans in the heads of these subjects, their previous exposure to products of the American media of mass

communication in home countries, and the extent to which personal experiences in the United States effected modification in the original opinions and attitudes held.

FINDINGS

It was found that the foreign students entering the State University of Iowa in September of 1959 possessed well defined, often stereotypical, attitudes toward the United States and Americans. They thought of the country as "a land of plenty," as "classless," and technically advanced. In relation to the four emphases of the study, they considered family life "loose" and lacking in depth; the standard of living "high" but centered too much in materialistic values; of economic advancement opportunities "good" in the United States but of racial segregation as an extremely negative factor in American life; and they thought of college students in this country as lacking in "seriousness."

In terms of the mass media focus of the study, it was found that most of the respondents were exposed to American motion pictures in their home countries. A smaller number were readers of American magazines; and there was minimum exposure among the subjects to American books, newspapers, radio, and television.

Evidence from this preliminary investigation suggests a strong link between exposure to the American media of mass communication and image formation. This study does not "prove" the case. However, it does point the way to more extensive exploration in this phase of cross-cultural contact from the standpoint of mass communication. Microfilm $9.80; Xerox $34.80. 773 pages.

ETHICAL CODES AND COURTS OF HONOR IN THE PRESS OF THE FREE WORLD

(L. C. Card No. Mic 61-1939)

Joe Bill Vogel, Ph.D.
State University of Iowa, 1961

Chairman: Professor William E. Porter

This study makes an evaluation and comparison of codes of ethics and courts of honor adopted by national journalism organizations among the "free-press" nations. Excluded from the study are nations listed as communist or authoritarian in the International Press Institute survey, The Press in Authoritarian Countries. A number of smaller countries--principalities, dependencies, or territorial possessions--are also omitted.

The study classifies four types of ethical controls instituted by journalists, sometimes with governmental participation. A section is also devoted to "free-press" countries where journalists have not adopted any type of national ethical guides or controls. The ethical controls (or lack of controls) for the sixty-two countries are described according to the following pattern:

a. National journalism organizations in thirty-three "free-press" countries have reported no systems of ethical control, i.e., neither codes of ethics nor courts of honor. (Chapter I) Reasons are given to show why journalists in these countries have not adopted any ethical controls.

b. In one country--the United States--two national journalism organizations have adopted codes of ethics but apparently do not believe that the codes should be enforced.

c. Journalism organizations in eight nations have set up systems to enforce ethical standards but have not adopted any codes of ethics to define those standards. Journalism organizations in Great Britain, West Germany, and the Netherlands have adopted national press councils, representing all major journalism organizations. The remaining five countries--Belgium, Finland, Luxembourg, Austria, and Switzerland have courts of honor representing single associations of journalists. Decisions of courts of honor of these associations apply only to members of the associations. (Chapter III)

d. National journalism organizations in seven countries have adopted codes of ethics and courts of honor for journalism. (Chapter IV) Three of these countries--Japan, Norway, and Sweden--have national press councils. The Australian Journalists' Association has a strong union code and court of honor. Irish and British working journalists (reporters, deskmen, etc.) have a trade union code and court of honor. The Israel Journalists' Association has an active court of honor. The South African Society of Journalists has a code and a court of honor, but the court of honor is not active.

e. In thirteen nations government participates--or government participation is proposed--in a scheme of ethical control of the press. (Chapter V)

In Argentina, Chile, Cuba, France, Mexico, Venezuela, and Greece, the government participates through sanction of a journalism union or association.

In India, Indonesia, Pakistan, Turkey, Lebanon, and Italy, plans for government participation in ethical controls on the press have been proposed but for various reasons the controls have not been applied.

Chapter VI offers a comparison of the seventeen national codes of ethics adopted by journalists in fifteen nations. Chapter VII offers an evaluation of the various attempts at control of press ethical standards by journalists. The author concludes that the national press council type of control--as found in Great Britain, Sweden, Norway, etc.--offers the best type of voluntary control for the press in the free world.

Microfilm $5.55; Xerox $19.60. 433 pages.

LANGUAGE AND LITERATURE, GENERAL

VARIANT FORMS OF ENGLISH AND SCOTTISH POPULAR BALLADS IN AMERICA

(L. C. Card No. Mic 61-1695)

Earl William Browne, Ph.D.
University of Southern California, 1961

Chairman: Professor McElderry

The object of this study was to compare American "survivals" of six representative English and Scottish popular ballads with the corresponding Old World versions recorded by Francis Child in his definitive collection, The English and Scottish Popular Ballads (1882-1898.) All of the Child Old World variants and most of the numerous American texts of "The False Knight upon the Road" (the supernatural), "Edward" (domestic tragedy), "The Cherry-Tree Carol" (Christianity), "Henry Martyn" (history), "The Farmer's Curst Wife" (comedy), and "The Brown Girl" (tragic love) are recorded in an extensive Appendix to this dissertation. These texts have been analyzed, criticized, and compared to ascertain whether the New World variants conform to the traditional requirements of the English and Scottish popular ballad.

Findings. A study of the ballads reveals that when compared with the Child variants, the American versions have not become more fragmentary or meager in narrative detail. They have gained in dramatic excellence because of a tendency to have a higher proportion of dialogue, but a loss of dramatic force does occur in "Edward" because the mother is not implicated in the crime and the son's tragic death is not implicit. Dramatic force also wanes in "The Brown Girl" when American sentimentality changes the tragic ending into a happy ending. On the other hand, the American folk have enhanced the drama of "The Cherry-Tree Carol" by eliminating the English carol ending and achieving proper dramatic unity. Although the Old World versions have somewhat more regular meter and rhyme, the New World versions have better refrains. As a result, the ballads on both sides of the Ocean are about equal in lyrical excellence. Likewise, there is little to choose between the diction of the best American texts and that of the Child versions. Crudities do crop up in some American variants, especially in the rollicking, boisterous "The Farmer's Curst Wife" and in versions of "Edward" from the Southern Highlands and the Ozarks, but the ledger is balanced by compensating gains in vigor and robustness. American variants display a continued effective use of the popular ballad techniques and characteristics of objectivity, focus on a single situation, playlet form, "leaping and lingering," hyperbole, understatement, irony, ballad commonplaces, inference of basic motivation and characteristics of individuals from the action, climax of relations, testament device, rollicking ballad meter, rhyme, incremental repetition, refrains, and general iterative style.

Conclusions. The American variants of the six selected Child ballads were found to have conformed to the traditional requirements of the English and Scottish popular ballad. The American folk have been the equal of their English and Scottish counterparts in preserving, molding, and transmitting these ballads. American versions of the tragic ballads have relinquished their Old World tragedy and ominousness, but American variants of the humorous ballads have taken on added zest and vigor, and the hero of "Henry Martyn" has become more heroic. A loss in one direction is compensated for by a gain in another direction. One concludion is inescapable: no account of what happened to the English and Scottish popular ballads is complete without a consideration of the American variants of the Child ballads.

Microfilm $7.20; Xerox $25.65. 567 pages.

A CONCORDANCE TO THE DRAMATIC WORKS OF JOHN HEYWOOD

(L. C. Card No. Mic 61-2083)

David George Canzler, Ph.D.
University of Oregon, 1961

Adviser: Oliver M. Willard

The "Concordance to the Dramatic Works of John Heywood" consists of full line citations to all words found in the plays and interludes commonly attributed to John Heywood--with the exception of sixty-seven common words--and of a word-frequency list of all words in the works concordanced. In addition to plays commonly ascribed to Heywood, three plays of uncertain authorship which have sometimes been attributed to Heywood have been included. The undisputed plays are The Play Called the Four PP.; John John the Husband, Tib his Wife, and Sir John the Priest; The Pardoner and the Friar, the Curate and Neighbor Prat; A Play of Love; The Play of the Weather; and Witty and Witless. Works that are questionably Heywood's, distinguished by an asterisk preceding each line citation, include Calisto and Melebea, Gentleness and Nobility, and Thersites. The text is based on the earliest known edition of each play, with the exception of Witty and Witless, based on the text in Roland de la Bere's John Heywood--Entertainer.

The words not cited are the common significations of the following:

a, am, an, and, are, art, at, be, been, but, by, can, could, did, do, done, for, from, had, has, have, he,

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

her, him, his, I, in, is, it, may, me, might, mine, my, nor, not, of, on, or, our, shall, she, should, that, the, thee, their, them, then, these, they, this, thou, thy, to, us, was, we, were, what, who, will, with, would, ye, you, and your.

In no case have partial citations been given. Homographs are separated, as are parts of speech in words containing a verb signification.

This concordance was made with IBM Electrical Accounting Machine equipment by a process devised by the author. In part it is an attempt to demonstrate that satisfactory tools for literary study can be made simply and efficiently with IBM accounting machines, as opposed to complex electronic computers. The Introduction contains, in addition to the usual prefatory material, a brief account of the procedure for compiling.

Microfilm $13.70; Xerox $49.30. 1095 pages.

DIDEROT ET LE THEATRE DE LESSING. [French Text].

(L. C. Card No. Mic 61-1924)

Cordelia Jasutyte, Ph.D.
State University of Iowa, 1961

Chairman: Professor Janis B. Ratermanis

"Lessing is a miracle"; that is how Albert Malt Walter begins his book, Lessing (Das Erwachen des deutschen Geistes). This citation seems eloquent enough; it is hardly necessary to insist further upon the importance of Lessing to Germanic letters. Hence, our interest in his relationship to Diderot is easily justified.

After examining the bibliography concerning the relationship between the two authors, we became aware of a certain want of precision. Therefore we decided to make a more precise study of the similarities existing between Diderot and Lessing from the standpoint of their aesthetic ideas on theater and the application of these ideas in the creation of their dramatic works. Our intention has been to examine the resemblances between these two authors and we have tried as far as possible to specify any influences which could have been exerted upon the German writer by his French contemporary. To achieve this goal, we have begun by a study of their criticism of the classic theater to see whether or not in both cases it was based on the same moral, philosophical, and aesthetic principles.

We have also tried to show whether or not they are in agreement, at least partially, upon what constitutes the desired nature of the drama, and to what extent Lessing could have drawn inspiration from Diderot in the formulation of his opinions concerning these questions.

After this consideration, it then became necessary to analyze the dramas of Lessing at the same time taking into consideration the theater and the aesthetic principles of Diderot, and we have concluded that Lessing made no pretense of adapting the theories of Diderot solely for a polemic purpose as is admitted too often and too hastily, but that he absorbed them and made use of them in his dramas Minna von Barnhelm and Emilia Galotti. We have come to the conclusion that the affinity which exists between these two writers is much closer than is generally acknowledged.

Hence, it has been our intent to prove that Diderot is indeed the genius that Lessing, by his own admission, has favored as his inspiration, and that his influence on the German writer was profound and decisive. In reality it is very easy to be mistaken about the basic conception of influence, especially when one is as independent as are Diderot and Lessing. There is influence only if the ideas, the suggestions, and the examples are assimilated into the individuality of the imitator.

According to this interpretation the influence of the aesthetic writings of Diderot upon the theory and practice of Lessing is undeniable, but this influence is far from being an infringement upon the freedom of Lessing. He is too original a creator not to express himself freely over and above the influence of the French dramatist. The example of Diderot encouraged him to give to his dramatic work a national and family feeling or trend, a closer attachment to everyday life and to contemporary problems.

Microfilm $2.75; Xerox $6.80. 145 pages.

EROS AND RELATED ASPECTS IN SPITTELER'S WELTANSCHAUUNG

(L. C. Card No. Mic 61-160)

Vincent LoCicero, Ph.D.
University of Illinois, 1960

Our investigation attempts to correct what we consider to be misconceptions about Carl Spitteler's Weltanschauung. So frequently does our author proclaim the world and life to be evil that he is all too often called a materialistic pessimist who grants positive value only to purely spiritual ideals.

In examining the matter throughout Spitteler's works, we find that, beside the poet's many denunciations of our present world, they also contain expressions of praise and gratitude for life as it is. The resulting paradox, we feel, can only be resolved by admitting that Spitteler has two distinct philosophies of life. One is an "absolute" view in which our world appears damned because it is measured against perfection. Here Death alone provides an escape. Having established this, we devote our attention to the clarification of what we call Spitteler's "practical" or "realistic" Weltanschauung.

As a realistic thinker, Spitteler neither condemns nor praises life per se. Rather, he believes that man himself makes life evil or good, particularly as man responds to eros. Eros is our designation for the dualistic instinct, which, in Spitteler's writings, guides creatures and humans to fulfill life in love. Contrary to the prevailing opinions, we maintain that Spitteler never urges repression of the instincts.

Our investigation of our author's treatment of women corroborates this. Only life without love strikes him as being bleak and senseless. Spitteler did not, as has often been contended, regard women with the same feelings as Schopenhauer. The demonic women supporting such a contention are not what Spitteler considered typical women; they are carefully constructed cases of erotic frustration. Spitteler not only admires the well-adjusted woman, but he

considers her the indispensable source of inspiration and guidance for the man whom she loves. True, in his way of looking at things, only the man may achieve greatness because of his more intense libido, but woman may share in man's greatness by heeding her natural inclinations and by identifying herself passively with her lover.

We show that overcompensation for a feeling of inferiority, together with the inability to accept male superiority, motivates Spitteler's vicious women to want to destroy the men whom they encounter. Spitteler makes it plain that such women act counter to their natural dispositions. A most notable example is that of Aphrodite in Olympischer Frühling. This devilish goddess confesses in a dream that every woman really desires to subordinate herself to a man, but that she herself cannot obey natural desires. Thus, life is evil to such a woman precisely because she cannot love.

To demonstrate further the importance of love as a factor in Spitteler's realistic Weltanschauung, we proceed to analyze his concept of love. Particular attention is devoted to the problem of human isolation, for Spitteler, like the contemporary American psychologist, Erich Fromm, shows us that without love we are not only separated from our fellow man, but also from ourselves. The relationship of two lovers, moreover, must be physical as well as spiritual according to Spitteler.

Since the work of art is seen as an expression of love by Spitteler, it also is dualistic. Particularly in his essays, Spitteler reveals his belief that eros is the basic force moving the artist. In his final epic, Prometheus der Dulder, artistic fulfillment is tantamount to union with humanity as a whole.

That Spitteler as an artist was not the ascetic sufferer he is often made out to be becomes evident from his exclamations in letters and essays describing artistic endeavor as the means by which man may experience the greatest possible happiness. And artistic endeavor, we deduce from his entire writings, involves a conscious sublimation of eros.

Love, then, either expressed in the work of art or in the union of two individuals, is the primary value in Spitteler's heretofore ignored realistic Weltanschauung.

Microfilm $3.40; Xerox $11.95. 263 pages.

EZRA POUND AND THE MEDITERRANEAN WORLD

(L. C. Card No. Mic 60-6564)

Andonis Manganaris-Decavalles, Ph.D.
Northwestern University, 1960

Ezra Pound has been among the writers of our time who, conscious of the modern need for culture, have made world literature, art, and history the field of their interest, research, and inspiration. His primary concern, in his search for artistic, political, and economic values, has been to provide America with worthy examples from the past, including her own, and thus enable her to achieve a new renaissance.

Pound's early choice of the Romance languages as his academic field was decisive in that it marked his major lifelong preferences and orientations. It was a first step into the Mediterranean world which was gradually to become his physical, as well as his intellectual and emotional home. For him the Mediterranean world has been the inexhaustible source of life and culture, and he made it his life's effort to bring the western world, the Anglo-American world in particular, into another fruitful contact with its values long since blurred by Usura and its practices.

Throughout Pound's work the Mediterranean world stands as the norm. Upon this norm, in a later stage, Confucian China came as an improvement. For Pound, Confucius' relative superiority over the Greco-Roman thinkers lies mostly in his expressive medium, the ideogram, through which his philosophy, though not basically different from theirs, is nevertheless expressed in a more substantial, clear, earthly, and concrete way as to achieve its cultural function of improving society. In his later poetry Pound made an English equivalent of the ideogram be his expressive medium.

From his contact with the Mediterranean world Pound derived a multiple profit. It gave him the foundations for his poetic, critical, and ideological creed, and inspired his poetry with its major themes and patterns, and a thematic, artistic, and ideological unity. This dissertation examines Pound's debt to the Mediterranean world, his gradual discovery in it of "pure colours" for his own palette, as well as for those of his contemporaries and the younger generations. Most of the poems in the collected Personae try to recapture and make new the musical cadences and the spirit of prototypes borrowed from Provence, early renaissance Italy, Greco-Roman lyricism and French symbolism. In them Pound found examples of what he calls melopoeia, phanopoeia, and logopoeia. His manner of presentation he borrowed from the personae of Robert Browning.

Hugh Selwyn Mauberley and Homage to Sextus Propertius are Pound's best achievements before the Cantos. Mauberley contains most of the techniques, themes and attitudes in Pound's early poetry, especially in the Lustra poems. It stands as a farewell not only to England but also to what is already worn out in the art of poetry. It points to an impasse, to a point of darkness, and the need for something new.

It is from this point of darkness that the Cantos begin, symbolically from Odysseus' descent to the underworld. In them the poet's word, like Odysseus, comes up into the light again to travel in resurgences through time and space upon the sea of man's experience where myth, legend, history and anecdote meet in universal and recurrent patterns. The ground theme and structure in the Cantos are borrowed from the Odyssey, the Divine Comedy, and the Ovidian Metamorphoses. The hero, with his changing faces, sails on the sea symbolically expressed as a dangerous female. She is the greatest test of his capacity to fulfil his manhood, to conquer hell and suffering, and to reach his goal as a lover, noble leader, and creator. He must achieve a metamorphosis in attaining an earthly paradise, in building an indestructible city of order, or in creating a difficult beauty.

In the Pisan Cantos, with the analysis of which the present dissertation ends, Pound uses his experience at Pisa to bring his major themes and motifs into a new composition, focus, and emotional unity. Here the principal hero, emerging into an earthly light of love, humility, and

compassion, after and through the darkness of suffering, is the poet himself and all of humanity and its history.

Microfilm $6.65; Xerox $23.65. 523 pages.

A COMPARATIVE STUDY OF FRANZ KAFKA'S DER PROZESS AND ALBERT CAMUS' L'ETRANGER

(L. C. Card No. Mic 61-1777)

Phillip Henry Rhein, Ph.D.
University of Michigan, 1961

The purpose of this study is to analyze the relationship between Kafka's Der Prozess and Camus' L'Etranger. Through consideration of the narrative devices, the perspective, the symbolism, and the philosophy employed by Kafka and Camus, the wealth of similarities is elucidated.

In Part I of the study, the problem is defined. Der Prozess and L'Etranger are placed in historical and critical context. Following an outline of the major writings, attention is focused upon Camus' interest in Kafka's writing and a detailed analysis of Camus' essay "L'Espoir et l'absurde dans l'oeuvre de Franz Kafka."

In Part II of the study, the narrative devices employed are compared. The significance of time to the protagonists, the protrayal of characters, the creation of settings, the emphasis upon sense impressions, and the use of counterpoint and irony are analyzed. It is concluded that in the presentation of the details that keep the reader constantly in touch with reality lies one of the major similarities between Kafka's and Camus' writing.

In Part III of the study, the central theme of Der Prozess and L'Etranger is found to be critical of a contemporary world in which false values triumph and real values lose. In both novels, society is played against the individual, and by mere strength of numbers is victorious. Through the inept functioning of the civil and clerical courts in the condemnation of K. and Meursault, the mechanical and preconceived notions of society are ridiculed. The social formulas concerning the pattern by which man must live and the hopes proffered by religion for man's salvation are made to seem ridiculous in their inability to aid K. and Meursault in their search for understanding of their arrests. In allowing K. and Meursault to die, Kafka and Camus accuse the false social structure that brought about these deaths, and simultaneously plead the cause of the individual in modern society.

In Part IV of the study, the symbolism of the novels is compared. The central action is seen to involve a trinity of characters representative of the father, the mother, and the son. A link between the philosophical and psychoanalytical viewpoints is found in the authors' use of natural symbols. In Der Prozess light and dark, air and airlessness; and in L'Etranger the sun and the sea are clearly associated with the mother and father images. Throughout both of the novels, ordinary details are discovered to have meaning beyond their immediate significance.

In Part V of the study, the philosophical theses are compared. The protagonists must go through the agonizing experience of affirming that the infinite value of life lies in the finiteness of its nature. K. and Meursault, although they conduct their lives according to polar value standards, essentially experience the same stages of development. For both of them, the existence which they had been leading is brought into question; they both reject the rational explanation of man's position proffered by the law and the irrational appeal of religious dogma; in spite of constant personal defeat by the complexities of day-to-day living, both reject suicide and affirm the value of life; finally, as a consequence of their failure to surmount or eradicate the finiteness of existence, they recognize the absurdity of life and the potentiality of man gains new dignity through this recognition.

Three conclusions are drawn from the study. 1) In Meursault, Camus portrays a hero similar to Kafka's Josef K. 2) Through the development of the characters of K. and Meursault, Kafka and Camus center upon the essential ills of twentieth-century man. 3) Both artists have created novels which can be richly compared to give the reader an additional insight into the creative process.

Microfilm $2.75; Xerox $6.80. 144 pages.

SOCIAL CONCEPTS IN THE STAGE PLAYS OF CLIFFORD ODETS

(L. C. Card No. Mic 61-2066)

Robert Baird Shuman, Ph.D.
University of Pennsylvania, 1961

Supervisor: Professor Edgar L. Potts

The central purpose of this dissertation was to evolve a clear idea regarding Clifford Odets's social concepts and their development as seen in the body of his published stage plays. Further, the dissertation sought to organize and state the over-all social content of the plays, to present Odets in relation to his times, and to evaluate the plays as literature.

In order to achieve these goals, the writer first presents a brief biography of Odets, viewed in the light of some of the broad social tendencies of the era in which he first became known as a playwright of note. The development, purposes, and method of the Group Theatre are also sketched in.

The second major section of the dissertation is divided into four parts. The first part considers the early and better known Odets plays: Waiting for Lefty, Awake and Sing!, Till the Day I Die, Paradise Lost, and Golden Boy. The second part deals with the Odets plays which are primarily concerned with love and marriage: Rocket to the Moon, Night Music, and Clash by Night. The third part is concerned with the later plays: The Big Knife, The Country Girl, and The Flowering Peach. The fourth part is composed of a brief general conclusion. Each play is considered in relation to (1) the basic social problems that are apparent in it; (2) method and effectiveness of characterization; (3) over-all literary merit; and (4) general critical reception.

An exhaustive study of the plays and of the literature written pertaining to them revealed that Odets's basic social concerns had not altered drastically in the course of his career. It revealed further that the critical response to his later works was often negative in character because the critics tended to compare these works with

the earlier works of the author. Many critics were unwilling to recognize that, while Odets's social concern had turned from the dead issues of the thirties to what he considered the living issues of the forties and fifties, he was still, in his later plays, socially conscious. He was sensitive to and aware of the same general problems of society, but his artistic scope was broadening.

The general conclusions reached in the study were that (1) Odets is vitally interested in the falseness of society and in the effect of that falseness upon human existence; (2) the family is generally regarded in the plays as the most fundamental social institution; (3) a social good is not attainable unless man has the opportunity to gain security in a way which will not necessitate his compromising his ideals; (4) in turning from the particular problems of the thirties, Odets demonstrated artistic versatility; (5) personal success did not cause Odets to abandon his interest in the lower and middle classes; (6) Hollywood, instead of ruining Odets as some critics have implied, has taught him to write more adroitly and in a more polished style than he did in the earlier plays; (7) Clifford Odets has passed from an attitude which had strong overtones of negation, to an attitude which, in The Flowering Peach, is notably affirmative.

Microfilm $3.35; Xerox $11.70. 259 pages.

TWO ANALOGIES FOR POETRY IN THE SEVENTEENTH CENTURY

(L. C. Card No. Mic 61-1910)

Myron Wilfred Taylor, Ph.D.
Washington University, 1961

Chairman: Joseph H. Summers

This dissertation is a study of the two most prevalent critical analogies for poetry in the seventeenth-century period. While other analogies were used, those drawn either from painting or history occupied a position of special importance, since most critics and poets paid homage by imitation to the two major critical traditions. The analogy with painting, enunciated in the critical writings of Plato and further elaborated by Horace, was used by those writers who wanted to see poetry primarily in terms of description. The analogy with history, given a dominant position in the writings of Aristotle, was valuable to those theorists who wanted to study poetry in terms of narration. This study attempts to illustrate the differences that exist between those men who talked about poetry in terms drawn from history and those, predominantly after 1660, who turned to painting both for vocabulary and ideas about the nature and function of poetry. The study attempts to ascertain the reason for the weakening of the historical analogy for poetry.

Chapter One of the present study traces the two analogies from their probable sources in Plato and Aristotle into the Renaissance period. An attempt is made to illustrate the considerable changes that the analogies underwent as classical humanism was replaced by Christian theology. After St. Augustine, the analogy between poetry and history was radically changed to fit the new ideas concerning the meaning of history. The initial chapter provides the background for a more intensive study of a group of seventeenth-century writers. Chapter Two takes note of the considerable changes wrought by Bacon in his use of the Aristotelian analogy. Bacon was instrumental in redefining the nature of history for the period. Chapter Three is concerned with the elements added by Thomas Hobbes to Bacon's ideas concerning the relation between poetry and history. These ideas are studied as they find expression in Davenant's epic Gondibert, dedicated to Thomas Hobbes. Chapter Four is a study of a number of historical poems written in the period between 1600 and 1660. It attempts to illustrate the close relationship that existed between critical thought concerning the historical poem and the actual practice of the genre. Denham's Coopers Hill is used as an example of the attempt to blend the pure historical poem with the painting poem, producing a new genre. Chapter Five begins a study of John Dryden's importance in redefining the critical analogies. Dryden termed his own Annus Mirabilis an historical poem, and he made subtle distinctions between this type of poem and the epic. An attempt is made to ascertain his ideas concerning the relationship between poetry and history through an intensive study of his own work. Dryden was more significant in influencing the change from history to painting as the dominant analogy for poetry. Chapter Six is a study of Dryden's essays and poems which reflect the change. Chapter Seven examines the effect of Milton's historical theory upon the structure of Paradise Lost. Since Milton's critical roots went back to an earlier tradition, it was difficult for the critics of the Dryden tradition, drawing their vocabulary largely from visual art, to understand him. Chapter Eight is a study of the later critics, and pays special attention to their ideas concerning Paradise Lost.

This dissertation is a study of the changing analogies for poetry in the period. The two traditions underwent drastic changes as the century progressed. The purpose of the thesis is to note the changes, and, as far as possible, to provide explanations for the process.

Microfilm $2.75; Xerox $9.45. 208 pages.

LANGUAGE AND LITERATURE, CLASSICAL

THE PHILOSOPHY OF HISTORY OF POMPEIUS TROGUS

(L. C. Card No. Mic 61-1656)

Joseph Sylvester Pendergast, S.J., Ph.D.
University of Illinois, 1961

The philosophy of history of Pompeius Trogus can be constructed from the epitome of the Historiae Philippicae made by Marcus Junianus Justinus, and from the prologi and the fragmenta. The origines of a city, tribe, or people, and the incrementa have important places in the methodology of Trogus. Although these two distinct periods represent in some ways a Golden Age for Trogus, it is not clear from the places in which he discusses them whether they are an age which one day may return or whether mankind is doomed to inevitable decline.

Imperium, to which Trogus is hostile, included a control originally acquired by war with neighboring peoples, desired by the monarch for selfish reasons, and maintained by a continua possessio. The facts of the Historiae Philippicae are organized around the four great empires: Assyria, Persia, Macedonia, and Rome.

The references to Rome throughout the work, in many of which some scholars have seen an attitude hostile to Rome, show upon analysis that the charge of Trogus' being anti-Roman is unfounded. Rome's position in the Historiae seems best explained by seeing in her the focal points of all lines of history.

The nomothetes are the great men of history. Trogus thought of three distinct ways in which the life of a people could be regulated: by generally accepted standards of conduct spontaneously obeyed because they are part of the ethnic ingenium, by decisions made by rulers, and by a system of formulated law, which promoted the vita cultior.

Trogus distinguished two types of war in the Historiae according to the motive which instigated them, glory and power, and the peoples against whom the wars were waged, finitimi, or people who lived at a distance. To war in general Trogus was opposed, as he also was to the acquisition of wealth through booty, an activity which he considered enervating to a people.

One of the praeterhuman forces active in history is fortuna. Although the nature of fortune is obscure as it appears in the Historiae, fortune is nevertheless an active force exerting influence on the lives of men and on the history of peoples. It can be a force in a man, but more often it is an external, though not absolute, force. A person can impose upon fortune and lose its assistance, and the changeability of fortune is noted. Fortuna can be influenced by other factors, such as courage, strength, and cleverness. Fatum appears only as an external agent over which men have no control.

The gods play an important part in the Historiae Philippicae, and they are treated with great seriousness and respect. Pompeius Trogus portrayed the Graeco-Roman gods as directly intervening in history in the lives of individuals and in the affairs of nations.

Oracles are treated with respect in the Historiae Philippicae. The actual deliverance of an oracle is never questioned, but an oracle never imposes a moral obligation. Men can bring an oracle to produce the results they themselves wish by straining its interpretation. There does not seem to be on the part of Trogus a conviction of oracles' authenticity.

Microfilm $2.75; Xerox $8.20. 176 pages.

A CRITICAL ANALYSIS OF THE HYPOTHESES CONCERNING OVID'S ERROR

(L. C. Card No. Mic 61-210)

John Crowell Thibault, Ph.D.
University of Illinois, 1960

This dissertation presents an historical survey and a critical analysis of the hypotheses which have been formulated about the nature of the mysterious error that Ovid committed and for which Augustus in person, toward the end of the year 8 A.D., presumably after a secret hearing, publicly sentenced the fastidious poet to a harsh exile in remote and barbaric Tomis, ostensibly because he had written the Ars amatoria ten years before.

That an error which resulted in such serious consequences to a famous poet should leave so few traces of its exact nature is strange, indeed, but may be explained either by official censorship, though there is no extant account in which the omission of the story is particularly significant, or else by its inclusion in histories and records now lost to us, in which Ovid's exile may have been fully explained.

Ovid himself, while lamenting that he had written the Ars amatoria, obviously considers the poem to be merely an official pretext for his punishment, which was really caused by a much more serious incident, in which he seems unexpectedly, though not illegally, to have seen a crime committed by a person, or persons, who were probably connected more or less intimately with the imperial family. Even this, however, may have been only a pretext, so far as Augustus was concerned, since it is possible he wished to prevent Ovid from discovering or revealing some embarrassing or important secret to which he unwittingly held the key, the importance of which he might have realized, had he remained in Rome.

At any rate, after Ovid's deliberately vague statements on the subject, extant ancient sources show only a silence that is first broken abour 450 A.D. by two statements, the first of which merely gives the official reason for the exile, while the second is dubious both as to meaning and as to source. In the Middle Ages a succession of scholiasts, whose intrepid ignorance is often exceeded only by the typically sensational character or egregious impossibility of their hypotheses, produce explanations of the "cherchez la femme" type, a solution to which the Mediaeval mind appears to have been naturally predisposed, whenever there arose a problem historical or literary which baffled its limited attainments and resources in the field of classical scholarship.

Later there came into vogue a different series of hypotheses based upon the idea that the error was political, presumably suggested or encouraged by the widespread political unrest and revolution of 19th century Europe. But today's intellectual climate fosters the type of hypothesis which finds Ovid's real error in an attitude and spirit of rationalism and atheism which clashed fatally with the dominant conservative elements in society.

Thus the numerous hypotheses on this subject fall generally into the three categories described, but a detailed analysis reveals that some of them are preposterous, others are at least plausible at first sight, while a few show great ingenuity; yet none is completely satisfactory, since all fail on several important points to satisfy the conditions imposed by Ovid's own testimony, on which, in the circumstances, we must entirely depend. However, the many and diverse attempts to solve this mystery have clarified the terms of the problem, its difficulties, and its limits, so that even if new evidence does not become available, it is possible that modern scholarship may eventually devise an hypothesis which will be cogent, even though certainty can never be attained on the basis of our present resources. Microfilm $2.75; Xerox $8.40. 185 pages.

LANGUAGE AND LITERATURE, LINGUISTICS

THE INVESTIGATION OF I-MUTATION IN THE GERMANIC LANGUAGES

(L. C. Card No. Mic 61-1591)

Elmer Harold Antonsen, Ph.D.
University of Illinois, 1961

The historical investigation of the mutated vowels can be properly dated from 1811, the year in which Rask recognized the relationship between the vowels of roots and endings in Modern Icelandic and thus established the historical basis of the phenomenon. Rask, however, was by no means without predecessors, for the mutated vowels had attracted the attention of scholars from the earliest times in North Germanic, where the first treatment still extant goes back to the twelfth century. A lively interest in the nature of these vowels developed in the sixteenth century in Germany, where the debate revolved about two poles: the theory that the umlauts were diphthongs, and its counterpart, that they were simple vowels. This debate was finally settled in the eighteenth century, when the monophthongal nature of the mutated vowels was recognized.

Rask's hypothesis was at first opposed by Jacob Grimm, until the latter, proceeding from a remark by Georg Friedrich Benecke, discovered that the umlauted vowels in German could be traced back to the influence of an inflectional or suffixal-i in the corresponding Old High German forms. It then remained for investigators to find the reason for the inflection of the root vowels and to explain the numerous exceptions. Early in the course of the investigation, it was recognized that mutation is basically a psychological anticipation, but this hypothesis was challenged by proponents of the palatal theory, who believed that mutation occurred by way of the palatalization of intervening consonants. The latter theory was proposed basically in order to expalin the discrepancy between the disappearance of the full endings in Old High German and the appearance of the mutated vowels in Middle High German, one of its main supports being the presence of so-called umlaut-hindering consonants. Further investigation of documents and modern German dialects, however, has shown that the mutated vowels were present long before they were regularly designated in writing and that the umlaut-hindering consonants did not actually prevent mutation, but probably merely determined different allophones which were not designated until later.

The chronological discrepancies in the designation of the various umlauted vowels also led to the formulation of theories, according to which mutation occurred during different periods, but these theories, too, have come under attack since the realization that phonological change and orthographic designation do not go hand in hand. In Scandinavian, the peculiar circumstance that mutation seems to occur regularly in long syllables, but not in short ones, led to the formulation of Axel Kock's famous three-period theory, which has recently met with strong criticism based on numerous inconsistencies within the theory itself and historical evidence which speaks against it.

The old argument that the mutated vowels written with digraphs and ligatures represent diphthongs was revived by adherents of the epenthesis theory, particularly for Old English, only to be refuted by counterarguments. The most recent trend in the investigation is the application of phonemic principles, which has succeeded in shedding some light on the problems involved, but still leaves many fundamental questions unanswered. The rôle of the Germanic stress accent, especially with regard to the relationship between umlaut and syncope or apocope, has come increasingly to the forefront in recent studies.

In this thesis, a critical appraisal of the investigation of i-mutation from the earliest times to 1959 is presented in chronological order. The closely related problem of the relationship between Germanic e and i is also treated in detail, as are the various theories concerning the spread or spontaneous development of mulaut in the separate dialects. Microfilm $6.85; Xerox $24.30. 537 pages.

SOME GRAMMATICAL CHARACTERISTICS OF APHASIC SPEECH

(L. C. Card No. Mic 61-1716)

Ralph Patrick Barrett, Jr., Ph.D.
University of Michigan, 1961

The purpose of this study is to provide and administer a test for obtaining a sample of aphasic speech for linguistic analysis. The test procedures are designed to obtain responses containing a variety of English grammatical features. The samples of speech elicited by the administration of the test to aphasic and non-aphasic subjects have been examined and compared, and the results are presented with respect to the quality and quantity of their respective responses.

A pilot test was constructed and administered to a group of non-aphasic subjects. Those test items which best restricted the subjects' responses to certain desired grammatical and lexical features were selected for inclusion in the final form of the test. The nine sentence patterns and the nine morphemes most consistently elicited were included.

Twenty aphasic subjects participated in the study. They were monolingual English speakers with at least an eighth grade education, and all were able to understand and respond to simple questions. The aphasic subjects were given a standard diagnostic performance test and according to their performance grouped and rated as to the severity of their aphasic impairment.

The grammatical feature tests were administered to the aphasic group and their responses were recorded. The responses were then classified and scored according to the acceptability of their grammatical form and lexical content with respect to the standard response established by the non-aphasic group.

A comparison of the classified responses of the aphasic group with those of the non-aphasic group shows that none of the aphasic subjects was able to achieve a non-aphasic level of performance with respect to the production of sentence responses. The use of statistical procedures shows that the number of acceptable sentences that the aphasics produced is highly correlated with their performance on standard tests of auditory comprehension, functional speech, and over-all severity of the aphasic condition.

By means of the use of statistical procedures applied to the scores it was found that (1) there was a significant difference among the scores of the subjects and also among the scores on the grammatical feature tests, (2) there was

no significant difference between the scores made by groups defined by their performance on the diagnostic test, (3) there was a high correlation between the aphasics' performance on the morpheme tests and the degree of severity of their aphasic condition, but only a general correlation between performance on the sentence pattern tests and the severity of the aphasic condition, and (4) there was a higher degree of intercorrelation among the morpheme scores than there was among the sentence pattern scores.

The results suggest the following general conclusions relative to the number and type of aphasic subjects who participated in this study: (a) There is a general order in the difficulty of the sentence patterns and morphemes for the average aphasic subject in this study, based in part on the function of these grammatical features and in part on the relative complexity of the procedures used to obtain them. (b) The aphasic subjects tend to perform more consistently on the morpheme tests than on the sentence pattern tests. (c) In general the subjects' performance on the grammatical tests appears to correspond well with measures of the over-all severity of their aphasic condition. Microfilm $2.75; Xerox $7.40. 158 pages.

SUBSTANTIVE MORPHOLOGY OF COLLOQUIAL EGYPTIAN ARABIC

(L. C. Card No. Mic 61-1739)

Muhammad Mahmoud Alsayed Ghaly, Ph.D.
University of Michigan, 1961

This study attempts to present a descriptive analysis of the substantives in the Colloquial Arabic of Cairo. Substantives are taken here to include both noun and adjective forms.

A portion of the data was gathered from four informants, who were born, raised, and educated in Cairo, and who resided in Ann Arbor for graduate study. Supplementary material was secured from glossaries of books about the spoken dialect of Cairo, as well as from the idiolect of the analyst, who lived in Cairo for nine years.

In the language, a substantive form includes one stem, which may occur as a free form. Such a stem has a minimum of two constituents: a consonantal root morpheme and a vocalic pattern morpheme. These two morphemes, which are usually discontinuous, occur intercalated in primary as well as in derivational stems.

There are three types of triliteral roots: roots with three different radicals, roots with identical second and third radicals, and roots with w/y in any of the three radical positions. Thirteen vocalic pattern morphemes occur in singular noun forms, eight in singular adjectives, nine in collective nouns, five in plural nouns, and three in plural adjectives. In all thirty-eight vocalic pattern morphemes occur in primary stems.

Derivational stems include, besides the constituent primary stems, at least one derivational affix. There are eight derivational affixes (prefixes and infixes) in the first derivational stems. The prefix /mu-/ invariably occurs with second derivational stems, and the suffixes /-i/, /-gi/, and /-a:n/ occur in third derivational stems.

Inflectional suffixes occur with primary and derivational stems to indicate gender (masculine and feminine), and number (singular, dual, and plural). A substantive stem may also co-occur with the definite morpheme as a proclitic, or with pronominals as enclitics, with the proclitic and the enclitics in mutual exclusion.

The following conclusions can be drawn from this study:

1) A substantive includes at least two morphemes: a consonantal root, and a vocalic pattern.

2) There are three root types occurring in substantive forms in the language.

3) Singular, collective, and plural forms are differentiated by the occurrence of suffixes or prefixes, or (especially with primary stems) by the occurrence of thirty-eight contrastive vocalic pattern morphemes.

4) Feminine singular forms, as distinct from masculine singular forms, have /-a/ in a suffixed position.

5) Dual noun forms have the dual morpheme /-e:n/ suffixed to the stems.

6) The plural suffix /-a:t/ occurs exclusively with noun forms, and /-i:n/ is suffixed mainly to adjective forms.

7) Pronominal forms occurring as enclitics with substantive forms display three persons--first, second, and third, two genders--masculine and feminine (with this distinction signalled only for the second and third person singular), and two numbers--singular, and plural.

Microfilm $2.75; Xerox $4.60. 87 pages.

VERB MORPHOLOGY OF MODERN GREEK: A DESCRIPTIVE ANALYSIS.

(L. C. Card No. Mic 61-1755)

Andreas Koutsoudas, Ph.D.
University of Michigan, 1961

The primary concern of this study is to present a descriptive analysis of the verb morphology of Modern Greek. The study also includes an outline of the phonology of the language, since a morphological description presupposes a phonemic analysis and since an explicit phonological statement could not be found in previous investigations of Modern Greek.

This study is based on the spoken language. The phonemic sketch is based on only one of the various dialects of Modern Greek; namely, that dialect spoken by two informants who were born, raised and educated in Athens, Greece. The morphemic analysis is based upon material elicited from the same two informants and upon the speech of the author, who is a native speaker of Alexandrian Greek.

With regard to the phonology, this study shows that there are five vowel phonemes, nineteen consonant phonemes, and one stress phoneme in Modern Greek. The following interpretations of consonant phonemes are presented and discussed: every palatalized non-vocoid is interpreted as a consonant plus a palatalizing phoneme, /j/, and the affricate clusters [ts] and [dz] are interpreted as the sequences /ts/ and /dz/ respectively.

With regard to the morphology, this study shows that every verb in Modern Greek can be fully described as a sequence of continuous morphemes; namely, (1) stem morpheme(s), (2) morphemes of voice-and-aspect, and (3) morphemes of tense-or-mood. It further shows that a

number of normalizations of the transcription are necessary in order to simplify statements of allomorphic distribution.

The following conclusions have been reached regarding the verb in Modern Greek:

1. The verb is composed of a base (or less frequently, of two bases) plus affixes (a prefix and/or a stem formative suffix). The margin consists of two groups of obligatory suffixes called (1) voice-and-aspect markers, and (2) tense-or-mood markers, which also indicate person and number.

2. There are two aspects--perfective and imperfective--, two morphologically marked tenses--non-past and past--, two numbers--singular and plural--, and three persons--first, second, and third.

3. The verbs have been divided into six classes and twenty-four types. Class refers to a grouping of stems on the basis of the selection of suffix allomorphs, while type refers to a grouping of stems on the basis of similarity of allomorphic alternation.

4. Stress is considered an integral component of the allomorphs of the voice-and-aspect suffixes.

Microfilm $2.75; Xerox $5.40. 107 pages.

A GLOSSARY OF COLOMBIAN COLLOQUIALISMS: BASED ON THE SPEECH OF COLOMBIAN MALES.

(L. C. Card No. Mic 61-1765)

Herbert Galt Meikle, Ph.D.
University of Michigan, 1961

This glossary presents the results of an attempt to gather colloquial vocabulary and expressions, including taboo words and phrases, used in the informal speech of Colombian males and not previously subjected to lexical study. The 'slangy' or racy language of the male has not previously been available for systematic study.

The study has three main objectives: (1) to discover terms and expressions used in the every day speech of educated Colombian males; (2) to classify these terms and expressions according to geographical, social and situational usage; (3) to compare the lexical material collected with that from other Spanish-speaking countries of Latin America.

A beginning in the collection of the material contained in the glossary was made by observing the speech of Colombian friends in informal situations. Later a questionnaire was prepared. The purpose of the work sheet, revised a number of times during the course of investigation, was to get at items of a slangy and unconventional nature. A total of forty-four informants contributed items to the study. For the most part, the informants represent the four main population centers of Colombia: Bogotá, Medellín, Cali, the Atlantic Coast.

The conclusions of the study are presented under three headings. (1) Linguistic aspects, dealing with loan words, morphemics, semantics and socio-cultural patterns; (2) Speech areas, an attempt to set up four tentative dialect areas; (3) Corrections of other sources, which compares the results of this study with work done previously by other compilers and lexicographers.

Microfilm $3.20; Xerox $11.25. 247 pages.

THE ECONOMY OF DIPHTHONGIZATION IN EARLY ROMANCE

(L. C. Card No. Mic 61-1330)

Luigi Romeo, Ph.D.
University of Washington, 1960

Chairman: Eugene Dorfman

The methods of functional and structural linguistics are used to re-evaluate paradigmatic diphthongization in Early Romance. Theories of diphthongal formation are reviewed historically and the phonetics of the diphthong is discussed. Attention is then given to the study of the function and structure of vocalic systems as they operate in Indo-European, Classical Latin, and Vulgar Latin. Finally, the vocalic systems of General and Early Romance are analyzed on the basis of the presence or absence of diphthongization in the stressed mid vowels.

The method followed in this investigation involves the conception and application of a Master Phonemic Diagram, which sifts all the mathematically possible vocalic structures. Structural calculations reveal that paradigmatic diphthongization never occurs in three-degree systems, but does occur in all early four-degree systems throughout Romania, as the result of two internal factors: (1) the relative pressure of the Classical Latin relic au; (2) the counter-pressure of the areas of variation at the different degrees of aperture. Structural theory also verifies that paradigmatic diphthongs always develop in the back series first, and that their integration in the vocalic system is conditioned by the formation of correlative partners in the front series.

This study throws light on a number of problems which for many years have been the subject of controversy, such as the chronology of the back and front diphthongs, the merging of the back mid vowels in "East" Romance, the cleavage between "East and West" Romance, and in addition presents a new typological classification of the Early Romance vernaculars according to their vocalic function and structure. Though scientific hypothesis provides the basis for the investigation, all accessible historical data are fully taken into account. Whenever historical evidence is available, this always coincides with the theoretical findings reached by functional and structural analysis in the framework of linguistic economy.

Microfilm $2.75; Xerox $7.60. 165 pages.

ESSAI SUR LA STRUCTURE PHONOLOGIQUE DU FRANÇAIS. [French Text].

(L. C. Card No. Mic 61-2071)

Lillian Szklarczyk, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Alphonse G. Juilland

This dissertation is a systematic study of French phonology made in accordance with an original method of structural analysis. This method is applied to a statistical universe of 100,000 words, compiled and computed with the aid of the electronic computer Univac and recorded on

electro-magnetic tape at the Computer Center of the University of Pennsylvania.

The functional method of structural analysis, developed by Dr. A. G. Juilland, is applied in this thesis, for the first time, to the field of French phonology. This method exploits the so-called "functional" or part-whole relations contracted by linguistic units on all levels: relations of phoneme to morpheme, of morpheme to word, of word to clause, etc.

The significant functional opposition is Initial/Final. Four basic positions are distinguished: 1. Initial; 2. Final; 3. both Initial and Final; 4. neither Initial nor Final, i.e. Medial. The relation of any constituent to its constitutes may be expressed in terms of these positions.

In this dissertation, the maximum unit studied is the word; the relations analyzed are those contracted by the word with its constituents.(syllable, group and phoneme) and by these constituents with one another.

For the purposes of this study, the French language is represented by a word frequency dictionary of 100,000 words, established and computed in the framework of a vast research project, embracing all five Romance languages, now being carried on under the supervision of Dr. A. G. Juilland and supported by the University Computer Center.

The electronic computer played a major role not only in the compilation of the statistical universe on which this study is based, but also in the statistical analysis of our data. Original programming routines have been devised for the breakdown of the word into its constituent elements, and for the computation of the various relations of occurrence contracted by these constituents with their constitutes. All our data—input, routines and dictionaries—are permanently recorded on tape and available for future linguistic studies. Such projects, based on the same materials and techniques and, therefore, scientifically comparable, will, it is hoped, serve to provide a more exact foundation for language research.

The functional analysis of each unit is preceded by an absolute study in which the relative frequencies of the phonemes, groups, syllables and words of the language are compared. Numerous frequency lists are provided, with proportions and mean frequencies.

As a result of this systematic application of the functional method of analysis to the language as represented by the statistical universe defined above, a number of significant phonological traits of the French language are revealed in this study. Consonants, vowels and semi-vowels are sharply differentiated by functional criteria. In relation to group, syllable and word alike, the consonant is characterized by a strong preference for the initial position; the vowel, by an equally strong preference for the final position. The semi-vowel occurs almost exclusively in medial position in relation to the syllable and to the word. In consonant groups, the semi-vowel tends to behave as a vowel; in vowel groups, as a consonant.

This correlation (consonant: initial = vowel: final) is repeated on the level of the group. Consonant groups favor the initial position; vowel, the final position.

The most frequently occurring syllabic type is CV (consonant + vowel), on the phonemic level, and KW (consonant-segment + vowel-segment), on the sectional level. The majority of syllables are composed of monophonemic segments; groups are relatively rare.

Microfilm $18.45; Xerox $65.95. 1465 pages.

A PHONOLOGICAL AND MORPHOLOGICAL STUDY OF THE SPEECH OF THE NEGRO OF MEMPHIS, TENNESSEE.

(L. C. Card No. Mic 61-1811)

Juanita Virginia Williamson, Ph.D.
University of Michigan, 1961

The purpose of this study is to describe certain of the phonological and morphological features of the speech of the Negro of Memphis, Tennessee. It is generally recognized by linguists that the speech of the Negro does differ materially from that of the whites on the same economic and educational level of the area in which he has lived the greater part of his life. Distinctive Negro speech, the Gullah Dialect, is to be found only in the Sea Islands and in the Low country of South Carolina and Georgia.

Statements are, however, made which hold that certain characteristics are believed to be the specific property of Negro speech. Such statements are seldom based on systematic studies.

Few systematic studies of the speech of the Negro have been made. Statements concerning the characteristics of the speech of any group are of value only when they are based on a systematic description of that speech. This study attempts to describe systematically the speech of the Negro of one urban area, Memphis, Tennessee.

The study is limited to a description of the segmental phonemes, their occurrence in the speech of both the educated and of those who have had little or no formal education and to certain features of the morphology.

For the purposes of this study the short work sheets of the Linguistic Atlas of the United States and Canada were used. Twenty-four informants, ranging in age from twenty-seven to eighty-four years, were interviewed. All except one, who came to Memphis as an infant, are native Memphians. They are classified as type I, those who have had less than an eighth-grade education; type II, those with a high school education; and type III, those with a college education. They are further grouped into three groups, younger, middle-aged and older.

The phonetic notation used in transcribing the responses is that used in recording the material for the Linguistic Atlas of New England.

On the phonological level the distinguishing features of the speech of the Negro of Memphis are to be found primarily on the sub-phonemic level and in the incidence of the phonemes rather than in the phonemic system itself. The phonemic system does not differ greatly from that of other dialects of American English in which final and pre-consonantal /r/ is not preserved as such. Like the dialects of Eastern Virginia and of South Carolina it has a free low unround vowel /ɑ/ as in car, garden, and a semi-vowel /ə̯/, as in fire, wire, which has generally replaced /r/ in the final and pre-consonantal position. On the sub-phonemic level the most distinctive feature is that all of the stressed free vowels are usually upgliding, all of the stressed checked vowels, monophthongal or ingliding.

On the phonological level there are few marked differences in the speech of the better educated informants and that of the type I and II informants. Those which do exist occur primarily in the incidence of the phonemes.

On the morphological level, however, very marked differences do exist, especially in the verb. The type III

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

informants usually have the verb forms found in cultivated American English. Type I informants, frequently, and type II, less frequently, have other forms. These, the type I and II informants, generally have the same forms as the type I and II informants discussed in E. Bagby Atwood's A Survey of Verb Forms in the Eastern United States. The uninflected third singular appears to occur more frequently in the speech of the type I informants of this study than in that of the type I informants discussed by Atwood. Microfilm $2.75; Xerox $6.60. 139 pages.

LANGUAGE AND LITERATURE, MODERN

A STUDY OF THE PLOTLESS SHORT STORY IN TWENTIETH-CENTURY BRITISH LITERATURE

(L. C. Card No. Mic 60-4592)

Mary Virginia Bowman, Ph.D.
University of Virginia, 1960

This study of the twentieth-century plotless short story attempts to analyze its form, its purpose, and its achievement. The emphasis is on the literary techniques used as substitutes for the traditional narrative structure of plot; however, the development of the new concept of structure and the reasons for the neglect of plot have also been considered. Since the quantity of plotless short stories makes a consideration of this genre in every age and in every country impossible, this study is limited to the twentieth century and to the short-story writers of Great Britain.

It has been found that the experiments of various writers to find a substitute for the unity and structure of plot follow certain patterns. Four of these have been studied in detail.

Much of this experimentation has been to find ways to depict character through the life of the mind rather than through action or outward appearance. In this psychological age the most revealing aspects of character seem to us to lie in the dark recesses of the mind, which the writers have tried to portray by the stream-of-consciousness technique, the limited point of view, or an emphasis on the transitory mood, the illogical emotion, the forceful subconscious.

Another experiment has been to try to reproduce what Joyce calls an epiphany, the moment of vision when the experience has significance. In order to do this the elements of the story have been arranged around a key piece which integrates and makes meaningful the seemingly disparate details. Sometimes this revelation comes through the character's glimpse of the significance of his experience; more often it is only the reader who has the moment of vision.

A third important trend is the replacement of narrative structure by an abstract design borrowed from the spatial arts. Influenced by the theories behind the nonrepresentational art of the twentieth century, writers have arranged the details of the story according to a spatial pattern so that the structure of the story comes from this abstract design rather than from a sequence of actions and human relationships. Usually simple designs, such as the circle or the hourglass, are used since these are more easily reproduced in words, but an interesting technique is the attempt to imitate in words the more complex montage of the cinema with its shifts of focus and meaningful juxtaposition or repetition of physical details.

Modern writers of the short story have also borrowed from poetry to replace the traditional structure of plot. Using imagery and rhythm as unifying devices and emphasizing the suggestive rather than the definitive, they have given the short story the emotional intensity and the interesting stylistic texture of poetry.

Thus one finds from a study of the plotless short story that it is neither unintelligible nor formless. When one recognizes the pattern substituted for the traditional narrative structure of plot and understands the purposes that lie behind this substitution, the plotless short story is seen to be meaningful, artistic, and a worthwhile development in the history of the short story. By breaking away from the strict definition of the critics which limits the short story to the development of a single effect through a plot based on conflict, the plotless short story has widened the scope of the short story and has prevented it from decaying into a sterile formula.

Microfilm $3.55; Xerox $12.40. 275 pages.

HAWTHORNE'S UNFORTUNATE LOVERS

(L. C. Card No. Mic 61-1313)

Robert Louis Brant, Ph.D.
University of Washington, 1960

Chairman: Merrell R. Davis

Though little has been written about Nathaniel Hawthorne's love themes, an analysis of them contributes to our understanding of his philosophy and his work. We know that Hawthorne was a Puritan by temperament, and that for him sin was a stain upon the soul. The worst part of sin was its isolating effect. Throughout his works Hawthorne revealed a preoccupation with the problem of isolation. For him isolation meant being cut off from reality and from God. In a letter to Sophia he made clear that the only way back to reality was through love.

I derived the title of my thesis from a poem by Andrew Marvell, "The Unfortunate Lover," the last line of which may have influenced the last line of The Scarlet Letter. Marvell's poem treats love in a philosophical sense that suggests much about the theme of The Scarlet Letter; more important, it helped to define the subject of this dissertation: love in the Garden compared with love out of the Garden, a theme I trace through four of Hawthorne's works. I concentrate on the allegorical meanings for the most part, remembering Hawthorne's "inveterate love of allegory," and the importance he attached to the "soul meaning" of a work.

Hawthorne did not often write pure allegory, but in several works he came close to personifying three basic elements in the makeup of man: Intellect, Passion, and Spirit. By "intellect" I mean to suggest the complex meaning of "head" in Hawthorne's usage, and by "passion" the very complex meaning of "heart." By "spirit" I mean

to sum up a driving force in many of Hawthorne's characters: a force that makes man aspire to the otherworldly, the inner voice, the highest seeming good, to God. Hawthorne showed these three elements in conflict. Man after the Fall is seeking wholeness, but he is torn not only from without but from within by the warring elements of his own nature. Yet man searching for wholeness through love achieves greater glory, dignity, and meaning than he ever could have achieved in the Garden. Such is the theme of Marvell's poem, and such is the theme that I trace through these four works by Hawthorne: "Rappaccini's Daughter," The Scarlet Letter, The Blithedale Romance, and The Marble Faun.

In "Rappaccini's Daughter" Giovanni emerges by my interpretation as the central figure who is confounded by lust, lust being subtly defined by the events of the story as a mixture of desire for the absolute, the timeless, the transcendent, with imaginative anxiety before the stink of death. Dimmesdale, in The Scarlet Letter, has before the opening of the novel committed what he terms a sin of lust, a spiritual sin to the extent that it is brought about partly by lack of faith. This sin is intolerable to the spiritual minister whose main goal is salvation. Hester suggests the "passion through which the race continues," and for the most part she remains ignorant of Dimmesdale's true nature. Before Pearl, the symbol of their sin, can "become human" and tear away the veil of unreality surrounding her, both Hester and Dimmesdale must confess their roles as earthly mother and spiritual father. This allegorical meaning, an overtone, suggests man's divided nature. In The Blithedale Romance, the idealists attempt to deny man's basic nature symbolized by the Fall; they try to re-establish the Garden through brotherly love, but inevitably fail. I find that this novel provides almost a catalog of obstacles to both "private" and "public" love, a theme that is treated throughout on the literal and the allegorical level. In The Marble Faun Hawthorne poses the question, What would Adam in the Garden have been like anyway? The answer is Donatello, in Rome, who is ironically so shallow that his love is of little significance. Only after he has learned of sin, guilt, and sorrow, can he move toward the kind of love that can make man tragic and great. Microfilm $2.75; Xerox $8.00. 173 pages.

STUDY OF THE GERMANIC LANGUAGES IN THE SOVIET UNION (1934-1960)

(L. C. Card No. Mic 61-1359)

Joseph Lawrence Conrad, Ph.D.
The University of Texas, 1961

Supervisor: Winfred P. Lehmann

This dissertation is intended to survey the study of the Germanic languages (excluding English) in the Soviet Union during the years 1934-1960. In the early part of this period the New Doctrine on Language of N. Ja. Marr (1865-1934) exerted considerable influence on Soviet Germanic studies; for this reason a brief sketch of Marr's general linguistic theories and a detailed examination of his ideas concerning the origin and development of Gothic and German are provided in Part I. In Part II four major works produced during the period of Marr's greatest influence (1934-1940) are discussed. The increasing disillusionment with Marrist ideas and the final break of 1950 are described in Part III. Part IV treats Germanic linguistic investigation in the USSR since 1953; both the conservative attitude following the collapse of the New Doctrine and the increasing awareness of contemporary Western approaches apparent since 1956 are discussed.

Marr's special interest in German led him to link the Germanic languages to the hypothetical Japhetic language stage which, according to his description of stadialism in language development, represented the stage preceding the Indo-European stage. Using his technique of four-element analysis Marr discovered numerous "lexico-semantic equivalents" between German and Gothic and various Japhetic languages. He held that the Germanic languages were representative of the transitional stage between Japhetic and Indo-European.

Following Marr's death in 1934 emphasis shifted from lexical to syntactic investigation; four-element analysis was replaced by analysis of stadialism in syntax. Marr's students sought to correlate syntactic patterns in the Germanic languages and those of the Japhetic languages said to be based on the ergative construction. In their dissertations S. D. Kacnel'son, M. M. Guxman, and A. V. Desnickaja attempted to prove that such features as impersonal constructions, the Gothic passive voice system, ablaut in Germanic noun formation, and remnants of aspect in the Germanic languages were indicative of a former dependence on the ergative construction. In accord with the principles of the New Doctrine they emphasized the interdependence of language and thought and the conditioning of these by the social structure. Their findings apparently corroborated Marr's theories. The fourth major work chosen from this period is a monograph by V. M. Žirmunskij. Although a certain amount of Marrian influence is evident, Professor Žirmunskij's work was not dominated by the New Doctrine. Maintaining that loss of semantic content was the prerequisite for phonetic reduction in inflectional endings, he investigated the relation of inflectional endings to analysis in German syntax. He concluded that the gradual transition from inflection to analysis observed in German was an indication not of decay in the language structure, but of increasing complexity in the thought processes of its speakers.

By 1945 the New Doctrine's influence had degenerated and a "stagnation" in linguistic studies resulted. In the Soviet linguistic controversy of 1950 the New Doctrine was finally rejected by Stalin as fallacious, sterile, and anti-Marxist. Soviet linguists then concentrated on building linguistics into a Marxist science; publications were necessarily political in nature. In 1953 the political tenor lessened considerably, and Soviet scholars returned to traditional methods of linguistic investigation. The conservative attitude of the post-controversy period has generally continued to the present. Since 1956, however, there have been numerous indications of a growing receptivity for methods used in Western linguistic studies. The relative merits of structuralism and descriptive linguistics for study of the Germanic languages were vigorously debated at the conferences on Germanic linguistics held in 1956 and 1959. Yet while linguistic investigation by certain scholars reveals influence of Western thought, the majority of Soviet publications dealing with Germanic languages retain a conservative attitude toward contemporary linguistic theory. Microfilm $2.75; Xerox $8.40. 185 pages.

THE PROBLEM OF EVIL IN THE MAJOR NOVELS OF CHARLES BROCKDEN BROWN

(L. C. Card No. Mic 61-1732)

James John Coyle, Ph.D.
University of Michigan, 1961

The purpose of this thesis is to show that Charles Brockden Brown in his four major novels, Wieland, Ormond, Arthur Mervyn, and Edgar Huntly, was concerned primarily with resolving ethical and political theories rather than writing gothic romances. Brown, in common with other reformers of his age, suffered a loss of ideals when the French Revolution deteriorated into the reign of terror, and had to reassess his ethical and sociological tenets to come to terms with the society in which he lived.

By considering the novels separately, it can be shown that Brown in each one sought to solve certain definite problems and beliefs. To do this, he created the protagonists and environment that allowed these tenets to work themselves out to their logical conclusion. Thus Brown tested the validity of radical theories by showing their tendency to create various facets of evil. Briefly, Wieland shows the evils of religious enthusiasm and the viciousness of Godwinian theories of property and marriage; Ormond demonstrates the necessity of a sound education to detect the speciousness of radical systems of ethics and politics. Arthur Mervyn points out the duty of avoiding the occasions of evil and of physically banishing temptation. Edgar Huntly presents the baneful results that can come from a superstitious belief in demons, in consanguinity, and an excessive remorse for past deeds, coupled with a fear of merited reproach. To examine these facets of evil, Brown created highly-endowed villains and victims who reveal the springs for action in themselves and others by subtle and penetrating exploration into the subconscious regions of the mind. In addition, Brown's fragmentary writings, especially Stephen Calvert, show the same absorption with ethical problems, even though these are only briefly outlined.

This approach to the novels shows that Brown was increasingly abandoning his radical tenets and was reverting to orthodoxy. By the end of Edgar Huntly Brown had swung away from the belief in the perfectibility of man to a tacit belief in a form of innate depravity. He rejects the idea that society is responsible for man's vices and reaffirms the belief that man is the author of evil and society reflects the collective morals of mankind. In brief, Brown implicitly repudiates the radical beliefs of his youth, and explicitly condemns Godwin's philosophy in his last novel, Jane Talbot. Once reconverted to orthodoxy, Brown no longer writes soul-searching novels, and soon thereafter ceases to write creative fiction. Hence, in his four major novels, Brown wrote his way from scepticism to belief, from radicalism to orthodoxy.

Microfilm $2.75; Xerox $8.60. 190 pages.

FIELDING'S SHIFT IN INSTRUCTIONAL METHOD AS REFLECTED IN HIS EARLY PROSE FICTION

(L. C. Card No. Mic 61-1316)

Virginia Derstine, Ph.D.
University of Washington, 1960

Chairman: Glenn Leggett

Fielding's theory and practice change, with regard to the instructional function of the novel, as he moves from the comic satire of Shamela and the ironic satire of Jonathan Wild to the genial and "constructive" good humor of Joseph Andrews and Tom Jones and finally to the gravity of Amelia. The moral emphasis in the early work is on what "carefully to avoid" and in the late on what "eagerly to imitate." This study seeks to show that the shift, which is obvious in the progress from the comic Joseph Andrews to the almost un-comic Amelia, is also reflected in the earlier work in the movement from Shamela through Joseph Andrews. Chapter One reviews some possible reasons for the shift in Fielding's purpose and methods, in relation to some of the general trends and attitudes of the times in regard to the nature of man and the use of ridicule, and in relation to satiric theories and practices. The conclusion is that Fielding became distrustful of the deceitful tactics of satire--the concealment of the moral, the presentation of a warped world with the pretense that it is unillusioned reality, and the basic falsehood involved in the adoption of a fictional mask. His distrust may have been grounded in part on suspicions of gullibility and lack of discernment among a sizable part of his audience. (The novel reached a public with a greater percentage of the uneducated than the more select readers addressed by Pope and Swift.) Chapter Two, a discussion of Shamela, tries to show that the work, though imitative, bawdy, and short, has an instructional purpose as well as the intent to amuse, and is closely related to the later prose fiction in characters, incidents, and themes, but that they convey the instruction by the negative method of showing what is to be shunned. Chapter Three examines the instructional effect of the burlesque and other satiric usages and the Heartfree plot of Jonathan Wild, in an attempt to ascertain the author's moral purpose. The mock-biography is clearly meant as negative instruction, but whether the Heartfrees were intended to represent completely emulable models of virtue is a matter of critical doubt. Chapter Four studies Joseph Andrews, with a view to clarifying the nature of the shifts which occur in the work and which mark this novel as the point of departure to the positive-instruction purpose and method of Tom Jones and Amelia. Joseph Andrews becomes increasingly less comic and more purposefully instructive, with the emphasis going more and more to the positive or emulable-example type of instruction as the novel proceeds.

Microfilm $3.00; Xerox $10.60. 232 pages.

THE NOVELS OF JOYCE CARY

(L. C. Card No. Mic 61-1921)

Anthony Martin Friedson, Ph.D.
State University of Iowa, 1961

Chairman: Professor Frederick P. McDowell

This study discusses the fifteen novels which Cary completed and published; and examines the craft with which he portrayed a world where the conflict of freedom and authority causes continual ironic dramas. A division of the novels into six groups facilitates the analysis of the various ways in which Cary approached his major theme.

The first group comprises the African novels: Aissa Saved, An American Visitor, The African Witch, and Mister Johnson. The tensions in these narratives derive from the personal and cultural conflicts of the whites who administer civil authority and the Africans who rebel against it.

Castle Corner, a transitional work, is Cary's first historical novel. The majority of the action takes place in Ireland at the end of the nineteenth century. In this setting, the conflict of ruler and ruled is dramatized in the struggle between the Corners, the Anglo-Irish Protestant landowners, and their Irish Catholic tenants. But Cary shows the universality of the conflict in those portions of the novel set in England and Africa.

In the novels of childhood, Charley is my Darling and A House of Children, Cary explores his major conflict as it pertains to family life. The stories of Charley Brown and Evelyn Corner illustrate Cary's conviction that the imaginative development of children requires both guidance and encouragement.

An "Interlude on Style," shows how Cary's particular type of trilogy form is an extension of the objective style of his earlier writing; and how this form conveys especially well Cary's idea that objective truth can only be tentatively inferred from the distillation of a number of subjective truths.

The treatment of the first trilogy emphasizes Cary's skillful creation of first person narrators whose combined viewpoints illustrate the process of distillation. The three narrators reveal the conflict of freedom and authority within and among themselves. In Herself Surprised, the personality of Sara Monday presents a comic reconciliation of moral absolutism and moral anarchy. Wilcher, in To Be a Pilgrim, describes the world of a lawyer who lives by bureaucratic authority, but who yearns for freedom of the spirit. And, in The Horse's Mouth, Jimson concludes the trilogy with a triumphant celebration of freedom by an artist who knows, and lives, its dangers.

After the first trilogy, Cary wrote two third person novels which treat the conflict of freedom and authority as it pertains to historical change. The Moonlight is Cary's most misunderstood plea for a just appraisal of Victorian authoritarianism. A Fearful Joy, a picaresque companion piece, shows the role in history played by those whose personalities compel them to challenge conventional institutions.

The second trilogy is Cary's most ambitious attempt to show history at work on the lives of his characters, and to reveal the conflicting forces of freedom and authority in political life. Nina, the narrator of Prisoner of Grace, is a split soul. She is divided between Nimmo, the politician who is her first husband, and Latter, the lover whom she marries after she has divorced Nimmo. The personalities of both these men also contain elements of freedom and authority. Nimmo, in Except the Lord, is corrupted by political power, but his Protestant upbringing will not let him descend to despotism. Latter, in Not Honour More, is disgusted at the corruption he finds among those in authority; but his anger inclines him to implement by force his own conceptions of decency. The last trilogy thus conveys, with particular complexity, the conviction behind all Cary's novels that "freedom is all our joy and all our pain." Microfilm $7.00; Xerox $25.00. 551 pages.

A CRITICAL SELECTED EDITION OF WILLIAM MORRIS'S OXFORD AND CAMBRIDGE MAGAZINE (1856)

(L. C. Card No. Mic 60-3586)

Walter Kelly Gordon, Ph.D.
University of Pennsylvania, 1960

Supervisor: Frederick L. Jones

In January of 1856 William Morris brought into being a magazine "based on Pre-Raphaelite principles" which he called the Oxford and Cambridge Magazine, and despite its short literary life -- only twelve monthly issues -- it provided a medium of expression for the peculiar blend of medievalism and modernity so prevalent in later Victorian literature. This dissertation reprints, edits, and analyzes in some detail those selections from the Oxford and Cambridge Magazine which best exemplify the tenor of this new spirit which, taking its direction from the teachings of Ruskin, was soon to find expression in such diverse figures as Swinburne, Arnold, and the later Morris. This dissertation also attempts to attribute both the rise and discontinuance of the periodical to Dante Rossetti: the rise because the Pre-Raphaelitism of 1848-1850 gave impetus to the founding of Morris's magazine; the discontinuance because Rossetti was responsible for Morris's temporary diversion of interest from literature to art in the latter part of 1856. This diversion did not occur, however, until the Oxford and Cambridge Magazine had imparted a new direction to the Pre-Raphaelite movement -- the love of the past was now blended with a brooding dissatisfaction with the present and a sincere desire to ameliorate the evils of the nineteenth century through the example of the Middle Ages.

The emphasis throughout this edition is on the Pre-Raphaelite qualities of the magazine, and the periodical is treated as an organ of expression of Pre-Raphaelitism in its second phase, a period during which William Morris, Edward Burne-Jones, Cormell Price, Richard W. Dixon, Vernon Lushington, Wilfred Heeley, William Fulford, and Georgiana Macdonald were fusing the principles of The Germ with their own beliefs.

The dissertation is divided into two distinct sections, a general introduction and a section comprised of representative samplings from the magazine. The former treats the literary background of the nineteenth century periodical in general, the origin of the Oxford and Cambridge Magazine against this background, its general history, its

contemporary reception as determined by letters of nineteenth century figures and reviews in nineteenth century journals, and its literary worth. The second section is divided into four parts: essays, tales, poems, and reviews, the same four classifications that Morris and his Brotherhood decided would form the subject matter of the periodical. Preceding each of these four sections is an introduction treating such matters as the significance of the material contained therein, biographical data of the contributors, and literary source material where applicable. The selections from the magazine appear in almost all cases in their entirety and are accompanied by historical and critical annotation. Photographic reproduction of some of the magazine's original pages and of pictures of the contributors appear with the text.

Microfilm $7.90; Xerox $28.15. 624 pages.

HERMAN MELVILLE'S THEORY OF PROSE FICTION: IN CONTRAST WITH CONTEMPORARY THEORIES.

(L. C. Card No. Mic 61-1620)

Allen Hayman, Ph.D.
University of Illinois, 1961

Between 1844, when he returned to the United States after nearly four years in the South seas, and 1857, the date of The Confidence-Man, the last piece of prose fiction he published during his lifetime, Herman Melville was occupied with the writing of prose narratives and was evolving a theory of prose fiction which he discussed fragmentarily in letters, journals, reviews, prefaces, and the fictions themselves. This two-part study gathers together all Melville's comments that have a bearing on his theory of prose fiction and examines that theory to see if it affects the prose fictions themselves. Also it examines the theory of the novel held by contemporary professional literary critics and reviewers whose theories Melville all but ignored.

Part One is concerned with the theories of prose fiction presented and enunciated in seven American periodicals between 1844 and 1857: the North American Review, the Knickerbocker Magazine, the Democratic Review, the American Whig Review, the Literary World, Harper's New Monthly Magazine, and Putnam's Monthly Magazine. These periodicals provide a satisfactory cross section of important literary, political, and geographical points of view. Chapter I presents the general position of each periodical and indicates the amount of attention each gave to prose fiction. Chapter II presents the demands that critics and reviewers made on writers of prose fiction. Despite the diversity of the periodicals, there was a certain sameness in the subjects discussed and in the principles set forth. Whig or Democrat, Bostonian or New Yorker, Young American or conservative, the critics spoke on such matters as the uses of fiction, the aim of the novelist, the place of doctrines and opinions in fiction, what a novel was, what a romance was, the place of American subjects in fiction, and, most important, the need in fiction for what today is called realism. It is too widely thought that the demand for realism did not come into our literature until the work of Howells and his immediate predecessors. Yet this examination of these periodicals discloses that critics and reviewers had long been asking novelists to take as their subject "the ordinary course of things" and to treat this subject with minute fidelity. The demand for realism became especially loud during the middle years of the century when, ironically, the historical romance and the sentimental domestic novel were the most popular forms of prose fiction. This magazine criticism provides an essential part of the background against which Melville's theory of prose fiction evolved and helps to explain his erratic contemporary reputation.

Part Two is a discussion of Melville's theory and practice of prose fiction. Chapter III states Melville's theory, ordering his scattered comments. Since Melville saw the artist as a searcher after truth, which the artist-as-novelist expresses in his fiction, Melville's theory of prose fiction had little in common with the theories of most of his contemporaries, the notable exception being Hawthorne. Concerned with "probings at the very axis of reality" rather than with a "severe fidelity to real life," Melville felt that the surface verisimilitude of the realistic novelist was less important than the "vital truth" which he aimed at in his own fiction. Chapter IV sketches Melville's development as a writer of prose fiction, showing that with each succeeding book--at least through Moby-Dick--Melville demonstrated a growing concern with the possibilities of fiction. Attempting to capitalize on one literary vogue and then another (the book of travels, the sea tale, and the domestic romance, for instance), Melville wrote as a novelist throughout the thirteen years he tried to support himself as a writer--despite what he told his publishers and friends. The final chapter, bringing Melville's theory and practice together, shows how Melville used printed sources and autobiographical experiences (what he called "skeletons of actual reality") to construct his fictions. Also it summarizes Melville's career in relation to the demand for realism.

Microfilm $3.55; Xerox $12.40. 274 pages.

LUDWIG HEINRICH VON NICOLAY (1737-1820) AS AN EXPONENT OF NEO-CLASSICISM

(L. C. Card No. Mic 61-1746)

Edmund W. Heier, Ph.D.
University of Michigan, 1961

The aim of this study is to appraise the literary position of Nicolay, a virtually unknown neo-classicist in the literary arena of the eighteenth century, and to evaluate his contribution to the development of German letters. He belongs to the group of minor poets such as F. Matthisson, C. A. Tiedge, J. B. von Alxinger, and F. A. Müller, men prominent in their age but who were neglected in the twentieth century. As Wieland's closest follower of the neo-classical French-inspired group, Nicolay received as they did but scant attention in the history of German literature.

The bulk of this study consists of two parts. Part one deals, first, with the characteristic features of neo-classicism, especially those which had an obvious impact on Nicolay's work during his most productive years 1760-1790, and, second, offers a critical biography based

predominantly on hitherto unknown primary sources. This sketch shows Nicolay's relation with the contemporary writers, Gellert, Voss, Ramler, Friedrich Nicolai, J. M. R. Lenz, M. Klinger, Seume, and the composers, Gluck and Metastasio. Emphasis has also been placed on his position with the Russian Imperial Court as tutor to the Grand Duke Paul, as Russian state councilor, and as president of the Academy of Sciences in St. Petersburg to which he had been invited by the Empress Catherine II.

The second part of this study is devoted to the analysis of Nicolay's literary efforts which occupy many volumes. It comprises three chapters dealing with such literary forms as elegies, epigrams, fables, verse tales both moral and humorous, ballads, epistles, romantic chivalrous epics, Novellen, comedies, and tragedies. The result of this investigation indicates that Nicolay achieved considerable success in his literary works and enjoyed a certain degree of popularity in his time. For his fables and moral verse tales, written in the manner of Gellert, he is chiefly indebted to Lafontaine, Phaedrus, and La Motte. While his elegies repeated the motifs of the Roman elegists, Tibullus, Ovid, and Propertius, his epistles are the product of his own time though modeled on those of Horace. The comic verse tales and chivalrous epics were written in imitation of Wieland. While the former were based on the medieval French fabliaux and contes, the sources for the latter were drawn from the romantic epics of Ariosto and Boiardo. Nicolay's weakest works were his epigrams and his dramas. His own compositions written in the manner of the French classicists and his translations from Goldoni, Molière, and Racine comprise his work in drama. His ballads and his two Novellen, though based chiefly on historical material, pursue the moral purpose of the fable and the verse tale.

Several conclusions may be drawn. Nicolay was a defender of the French neo-classical orientation. In using the motifs of the ancients and those of Italian and French literature, he introduced German readers to foreign material. Though he lacked originality his graceful style contributed to the fluency of German verse. Finally, as Wieland's closest imitator he aided in the transition from stiff rationalism to the "Weimarer Klassik," and thus, as a worshiper of good sense, he deserves a modest place in the history of eighteenth-century German letters.

Microfilm $3.60; Xerox $12.60. 280 pages.

MR. HERBERT'S TEMPLE & CHURCH MILITANT EXPLAINED & IMPROVED BY A DISCOURSE UPON EACH POEM CRITICAL & PRACTICAL BY GEORGE RYLEY: A CRITICAL EDITION.

(L. C. Card No. Mic 61-144)

John Martin Heissler, Ph.D.
University of Illinois, 1960

When Richard Rawlinson, the antiquary, died in 1755, he bequeathed to the Bodleian Library, Oxford, some 1,414 manuscripts, one of which was Mr Herbert's Temple & Church Militant Explained & Improved by a Discourse upon Each Poem Critical and Practical by George Ryley, dated at the end March 24, 1714/15. It was catalogued in 1810 as Rawlinson D 199. The search for positive identification of George Ryley has proved fruitless, and biographical evidence in the manuscript is slight. Occasional sympathetic references to the Anglican Church suggest that perhaps he was connected in some capacity with the established church, but his name does not appear in any of the available lists of Anglican ministers. That he was well educated is shown throughout the commentary in which he reveals some knowledge of the classical languages, and cites some of the main scientific, literary, and theological works of his day. With the help of these tools, he almost makes good his promise of "making Tollerable Sence" of every poem in his analysis of Herbert's The Temple.

Ryley was the first person to attempt a thorough and complete commentary on Herbert's The Temple, and the purpose of this edition is to show that his work is a serious, basically sound and original piece of critical scholarship. His commentary differs from the comparatively few earlier annotations on literary works, for his "denudations" of each poem are essays that seem to follow the typical seventeenth-century sermon construction. In general each begins with a proem, is developed by illustration and argument, and close with an application or peroration.

Ryley's commentary has been known by students of Herbert since the middle of the nineteenth century, but it has never before been edited. The first reference to it appears in Pickering's edition of The Temple (1844). Later scholars of Herbert such as Willmott, Grosart, Palmer, Hutchinson, and Summers refer to Ryley. Modern criticism of the poems has shown that most, if not all, of Ryley's analyses are generally sound, and in some, Ryley shows a more original and deeper insight than later critics, in part, because the commonplaces, emblems, and vernacular of Herbert's day were closer to and better understood by him.

Ryley's style is quaint. He intersperses austere prose with sudden idiomatic expressions and preaches against the sins of drinking, vanity, and lust. Personal evaluation of the poems creeps in rarely, but he recognizes that The Temple had been written a century before when poetic standards were somewhat different from those of his day and that the poems should be read with some historical understanding. He praises Herbert for his subject matter and for his use of metaphor and remains loyal to his own tongue, preferring it to Latin or Greek. He occasionally tries to emend lines without destroying the form or sense of the poem. By using such standards, Ryley, in a sense, rises above his age, and his "denudations," with few exceptions, remain valid today.

Ryley's method of interpreting The Temple is basically the same as that employed by biblical exegetes. He was very careful to follow Herbert's intention, to define words, to cite authorities, and to cross reference similarities between poems. It would appear that he followed Herbert's own method of biblical exegesis, using mainly the tropological and allegorical methods with a few literal and no anagogical interpretations.

This edition was prepared from a microfilm of the manuscript. The manuscript contains 166 leaves of closely packed writing and measures 6-3/10" x 4". Ryley probably began writing in 1714, certainly not before 1711, and completed the work on March 24, 1714/15. The edition of The Temple he used was most likely the third edition

of 1634, but the internal evidence for singling out this edition is inconclusive.

Microfilm $9.80; Xerox $34.85. 774 pages.

AN EVOLUTION OF THE NEW CHICAGO FROM THE OLD: A STUDY OF HENRY BLAKE FULLER'S CHICAGO NOVELS.

(L. C. Card No. Mic 61-2041)

Kenny Jackson, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Charles Boewe

Henry Blake Fuller (1857-1929) was one of the most accomplished writers produced by nineteenth-century Chicago, and his productivity extended into the twentieth century. Not only was he the first Chicago novelist to achieve national literary distinction, but also was he the first to expose the city stripped of all glamour.

Unlike many Chicagoans of his generation, Fuller was born in the city, the son of a bank official and the grandson of an early capitalist. In a city dedicated to the philosophy of material progress at all costs, it is perhaps a credit to his individuality that he dared to be different. While the young men of the city dreamed of various schemes which would lead them to riches, the young Fuller dreamed of Europe. While others read the stock-exchange reports, he read books on the arts. While others were becoming accustomed to their jobs in the fast-growing city, he was off in 1879 for the first of six European tours. Consequently while others praised Chicago and heralded her as the city, he could remember London, Paris, and Rome.

Although Fuller knew Europe well, he was never oblivious to developments in the city of his birth. He had known Chicago when her promise for a great future was in the offing. He had known her as she rebuilt a bigger and better city from the ashes of the Great Fire. He had seen her in 1893 challenge the rest of the country and the world with the Columbian Exposition, and he had partially agreed with the city's boosters that Chicago had "arrived" culturally and artistically. In the same year, however, he had forseen in The Cliff-Dwellers that Chicagoans would come to see themselves as the center of the world, and he lived to read Sandburg's celebration to the "Hog Butcher and Tool Maker" of the world. He had seen the materialism of the titans control the city. Yet, he had seen the brief and productive Chicago Renaissance of the early twentieth century, but he had noted that many of the artists who came into the city with hope left in despair. Fuller remained in the city fascinated and conditioned by its force.

In the last decade of the nineteenth century he knew it took more than phenomenal growth and great industrialism to make a real city, and he was not alone. In the midst of the sprawling city there were others, most of them migrants from New England, who felt that the city was developing too much in one area with a complete disregard for the establishment of culture. It is no wonder that he joined forces with this group consecrated to bringing the standards of the East into the West. They planned to set up a genteel tradition which would counteract the vulgar western tradition.

Fuller's first two novels, The Chevalier of Pensieri-Vani (1891) and The Chatelaine of La Trinité (1892), were set in Europe and seemed to be cast in the usual romantic tradition. Fuller was acclaimed by the advocates of genteel standards in Chicago as proof of the possible literary attainments to come out of the city. Yet, these two novels demonstrated the extent to which Chicago had influenced Fuller. Although Fuller shifted dominant emphasis from the seeming romanticism of these works to the more discernible realism of The Cliff-Dwellers (1893) and With the Procession (1895) in a six-year period, the four novels offer much which can be traced to Fuller's concern for the problems implicit in Chicago life. And if a misunderstanding exists about Fuller's work, it is based upon the veiled realism of the first two novels which are set in Europe. Fuller's so-called switch to realism, so acclaimed by Garland and Howells, was simply a change of locale which enabled him to examine more extensively the impact and influence of modern industrialism upon a society. He sympathized with the Chicago of his youth but never lost his interest in the emerging city, for he realized that the business and social groups which had been responsible for the initial development of the city had lost their power. It is perhaps ironic that Fuller, one of the leading exponents of the genteel tradition, became the first writer to set forth in fiction the deterministic nature of Chicago and to use it in order to show the results of a mechanistic way of life upon a city's populace.

Microfilm $3.95; Xerox $13.75. 305 pages.

THE LITERARY CAREER AND LITERARY PRODUCTIONS OF ERNEST POOLE, AMERICAN NOVELIST.

(L. C. Card No. Mic 61-1443)

Truman Frederick Keefer, Ph.D.
Duke University, 1961

Supervisor: Clarence Ghodes

The dissertation, The Literary Career and Literary Productions of Ernest Poole, American Novelist, consists of a detailed description of Poole's life and works, an evaluation of his various writings in an effort to determine whether any possess lasting literary merit, and an investigation of the causes of the decline of his reputation after the success of his first important works, The Harbor (1915) and His Family (1917), the first novel to win a Pulitzer Prize.

Poole's career as a writer extended nearly fifty years; it began in 1903 when he published his first work--a series of "muckraking" articles, eventually included several hundred magazine pieces and newspaper contributions, a dozen plays, of which three were produced, and twenty-four book-length works, seventeen of them novels, the last of which was completed shortly before his final illness. Early in life Poole decided to become a novelist and, to train himself for the role, for ten years worked as a journalist. Chiefly because of his perseverance in pursuing his goal and his patient endless revisions, he achieved in time a reasonable competence in written expression and,

after two years of hard work, produced The Harbor, a novel of class warfare on the New York docks. Then, after its success assured him that he had chosen the correct course, he devoted himself almost entirely to the composition of fiction. Journalism, however, had left its marks: he often relied heavily for material on real incidents and real people; his style lapsed frequently into the clichés of the newspaper world; and, because his career as a writer of exposés had resulted in his conversion to socialism, he usually loaded his stories with "message."

Poole's work as a whole is decidedly uneven in quality. Of his magazine contributions a handful of the short stories--usually those based on real incidents and people--still have life, and his reports on the 1905 Russian Revolution represent the high point of his work as a correspondent. As for the novels, the present writer feels that The Harbor and His Family deserve something of the reputation which still clings to them, but he believes that later works--With Eastern Eyes, and The Destroyer--are definitely superior and deserve a recognition which they never received. In these novels Poole showed a mastery of dialogue, description, and characterization (especially that of women) which rival the productions of all but the best authors.

The causes of the decline of Poole's reputation are several. He himself was partly at fault when he published work of inferior quality and when he stubbornly refused to write naturalistic novels when they were in vogue. Moreover, he was forced to compete in the Twenties with such newly arrived literary figures as Willa Cather, Lewis, Faulkner, and Hemingway. But, most of all, he was a victim of the incompetence of the reviewers, who too early accepted the idea that Poole's best works were his first and would never be equalled.

Microfilm $6.90; Xerox $24.55. 543 pages.

THE STRADDLERS: A CRITICAL STUDY OF THE BRITISH POLITICAL-LITERARY MIDDLE EAST TRAVEL WRITERS, 1900-1950.

(L. C. Card No. Mic 61-1287)

Musa Khuri, Ph.D.
The Florida State University, 1961

This investigation has shown that although members of the group were attracted to the Middle East by a variety of motives they had common characteristics including: Middle East travel, a sound academic education at a leading British university, a dual interest in politics and literature, a romantic idealistic feature, a rightist ideology, a belief in the imperialist ideals, and a scientific sideline interest.

The basic role of the British Middle East political-literary travel writers from 1900 to 1950--Gertrude Bell, T. E. Lawrence, Bertram Thomas, H. St. John Philby, and Freya Stark--was one of mediation between East and West, between British imperialism and Arab nationalism. Their adventurous careers provided an element of romantic idealism that saved the British imperial cause from having to rely exclusively on the realistic pursuit of self-interest. This study has shown that the special role played by these travellers throws light on the attitudes of the writers and explains certain features of their writing. Among these are the minute interest they take in the racial attributes and political loyalties of the various groups and classes of the population in the countries they visit, the preference they show for nomad life in the desert, the emphasis they place on the affinities between the Arab and the British people, and the scientific sideline interest which is a common characteristic of their careers and their writing.

This investigation of the position of these travelwriters as straddlers between politics and literature, between East and West, between realism and romance, has shown that this position influenced in varying degrees their attitudes and sensibilities. In Lawrence's case the influence was, during a few critical years in his life, sufficiently powerful to produce a tension in his soul. This partly accounts for the dynamic, restless quality of The Seven Pillars of Wisdom.

An examination of the style of the travel accounts of the other members of the group fails to reveal such quality in their writing. The beauty of the Arabian desert crept into their style but this had little or none of the dynamic, restless quality. The reason for this lies in that the political-literary writers--including Lawrence in the greater part of his Middle Eastern career--never went in their Arab sympathies so far as to allow these sympathies to affect their imperialist loyalties, change their basically British outlook, or produce an emotional tension in their souls. Lawrence, however, for a short critical period, experienced a spiritual tension and a sense of guilt at the broken Arab promises. In this critical period he wrote The Seven Pillars of Wisdom. Hence, the dynamic, restless quality of the book.

We have noted in conclusion that the story of the political-literary British travel writers has now come to a definite and final end for two reasons: First, the old society of the bedouin Arab, so different from that of contemporary society in the West and hitherto the chief attraction to the traveller, is rapidly changing under the impact of Western civilization. Second, the fact that British political pre-eminence in the Arab Middle East has now ended inevitably makes the role of the British political-literary travel writer irrelevant.

Microfilm $3.30; Xerox $11.50. 253 pages.

CHARLES WHIBLEY'S "MUSINGS WITHOUT METHOD": A CRITICAL SELECTION EDITED WITH BIOGRAPHY.

(L. C. Card No. Mic 61-2049)

Frederick R. MacFadden, Jr., Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Edwin C. Bolles

The problem in this work, which deals with literary journalism, was to select the writings produced by Charles Whibley for his "Musings Without Method" (1900-1929) which would be most characteristic of him.

The procedure employed was twofold. While gathering biographical material from source books and from

informants living in the United States and in England, the author spent the intervals between correspondence searching the "Musings" for the droll satirist sketched in D N B: 1922-1930. When the selections and data indicated that a full treatment of Whibley could be organized, final selections from the "Musings" were made on the basis of their relevance to the biographical data.

The results are a life and thought of Whibley which correspond. They show a scholar who achieved a versatile culture, and awesome disposition, and a prime sense of humor. They show him in substance a romantic, in form a classic, and yet in the art of biographical condensation, a pioneer. They illustrate Whibley as his readers dubbed him: pugnacious scholar, polemical dragoon, and Tory of Tories. They agree on what kind of man could have been such a power in his time as to champion the radical William Butler Yeats or befriend the flagrant D. H. Lawrence without losing respect in his own world. They agree on Whibley's reputation as the best prose stylist of his day, both in the writing of the "midnight darlings," as they were called, as well as in the writing of formal contributions which he made to the Dictionary of National Biography, to Farmer's Dictionary of Slang, and to the Tudor Translations. They affirm the value of his life and thought to his friends, among whom were Henley, Hardy, Barrie, Kipling, and Mallarmé.

There are three conclusions of the dissertation. One is that just as Bolingbroke was the inspiration of Toryism in the eighteenth century and Disraeli the man to whom it rallied in the nineteenth, so Charles Whibley stands for the Tory way of life in its final era. The second conclusion is that Charles Whibley, though a destructive critic in the true spirit of the Tory intellectual, is at the same time an edifying critic; he satisfies his own cardinal rule that the best purpose for print is delight and pleasure. Finally, the destructive criticism of the "Musings" has a value in its own right. Concluded just after the Crash (1929), it described a fast, noisy attempt by some people to achieve culture without tears. That attempt has been handed down, and while it persists, the "Musings," aside from their stylistic excellence, ought to be seriously read for the wisdom which they offer.

Microfilm $4.30; Xerox $15.10. 335 pages.

STRUCTURE IN THE EARLY POPULAR COMEDIES OF THOMAS DEKKER

(L. C. Card No. Mic 61-1410)

Leonard Michael Manheim, Ph.D.
Columbia University, 1961

Thomas Dekker has generally won favor as a poet and portrayer of the emotions but not as a constructer of plays. Structure in his comedies has been evaluated, however, on the basis of the cause-and-effect logic of the stories. This study proposes that, as in other plays of the age, a thematic structure exists along with the cause-and-effect, or narrative, structure of his early comedies, allowing for a unity not wholly dependent on cause and effect. Dekker juxtaposes analogous and contrasting situations, characters, and tones in a play as a means of varying and reiterating the play's underlying theme. These juxtapositions may interrupt the narrative line while enriching the working-out of the theme.

The study is divided into two sections. The first, which deals with plays deriving in theme and structure from earlier popular plays centering around a folk-hero, includes The Shoemakers' Holiday (1599) and Old Fortunatus (1599). The thematic structure of The Shoemakers' Holiday is found in its regular alternation between episodes depicting the merriment, honesty, and industry of the tradesman (Simon Eyre and Company) on the one hand and the unyielding pride and duplicity of the courtier (the Earl of Lincoln) or the pretense of the pseudo-courtier (Hammon) on the other. The attitudes the play celebrates go beyond class divisions: a nobleman possessing the tradesman's virtues (Lacy) is also placed alongside a proud and devious tradesman (Sir Roger Otley).

Juxtaposition of contrasting plots is the chief structural characteristic of Old Fortunatus. A theme of romantic degeneration is worked out in the contrast between the stories of Fortunatus' achievements and Andelocia's failures. Several parallel situations identify the antithesis between the two plots, and the theme is supported by contrasts in diction and poetic imagery. Old Fortunatus is an ambiguous play, however, because much of the Dame Fortune action and the Vice-Vertue masques work out a divine retribution them which is out of harmony with the play's dominant romantic theme.

The second section, which deals with plays involving the sufferings of a persecuted woman, includes Patient Grissil (1600) and the two parts of The Honest Whore (1604-c.1605). Thematic juxtaposition plays a small part in the structure of Patient Grissil. A sub-plot presents two female types who contrast sharply with the heroine, and, as in The Shoemakers' Holiday, the duplicity of the courtly life is presented in direct antithesis to the humble life of the shop. Otherwise, the well-known tale is an exemplum demonstrating the dictum that the good wife must be submissive.

The two parts of The Honest Whore work out the theme of conversion and penance in a courtesan. In Part I, Bellafront is converted by a moral youth with whom she falls in love. But her attempts to enter the world of love intrigue, embodied in a juxtaposed "Italianate" revenge plot, are thwarted, and she is finally forced to seek marriage with her first tempter as her only means of reinstatement in society. Part II works out Bellafront's penance. In a juxtaposition of three tests engineered by her disguised father Orlando Friscobaldo, the heroine proves her patience and resolution in contrast to Hippolito, her saviour of Part I turned tempter, and Matheo, her prodigal husband. Sub-plots involving Candido the patient linen-draper support the themes of both plays. The first sub-plot stresses patience, the virtue Bellafront lacks even after her conversion, and the second focuses on the dissolute life of the prodigal.

Thematic juxtaposition of plots or episodes thus is the chief structural characteristic in The Shoemakers' Holiday, Old Fortunatus, and II The Honest Whore, and strongly supports the underlying themes of Patient Grissil and I The Honest Whore.

Microfilm $3.25; Xerox $11.50. 252 pages.

COLETTE: A CRITICAL STUDY.

(L. C. Card No. Mic 61-738)

Elaine Marks, Ph.D.
New York University, 1958

Adviser: Germaine Brée

Sidonie Gabrielle Colette (1873-1954), though a prominent French writer of the first half of the twentieth century, has, to date, received little serious criticism. This may be explained by the fact that Colette's work is essentially outside of the important literary schools and trends of the twentieth century, and also by the fact that until 1949-1950, date of the publication by Flammarion of the OEUVRES COMPLETES DE COLETTE, certain of her writings were not easily accessible. This thesis contains a critical essay dealing with particular aspects of Colette's work, and an almost complete bibliography of French, English and American books, articles and reviews relating to Colette.

Both the quantity and the variety of Colette's writings are impressive. The fifteen volumes of the OEUVRES COMPLETES contain novels, short stories, plays, dramatic criticism, chronicles, prefaces, personal souvenirs, and portraits of men, animals and flowers.

In this thesis, certain works which represent either different periods, or different but essential aspects of Colette's writing, are given special treatment. These are: the five novels of the CLAUDINE series (1900-1907), LES DIALOGUES DE BETES (1904), LES VRILLES DE LA VIGNE (1908), L'INGENUE LIBERTINE (1909), CHERI (1920), LA FIN DE CHERI (1926), LA MAISON DE CLAUDINE (1922), LE BLE EN HERBE (1923), LA NAISSANCE DU JOUR (1928), SIDO (1929), LA CHATTE (1933). Each chapter of the thesis deals either with an important phase or an important theme of Colette's work: her early writings and the influence of her husband M. Willy, the relation between Colette's first person and third person writings, between the narrator "Colette" and the fictional character who says "I," the manner in which Colette composes her more successful novels, the particular use she makes of childhood and the figure of her mother "Sido," the unity which exists for Colette between all living things, her two styles and her particular kind of realism, the all importance of the word "Regarde" as the keystone of Colette's point of view on life and on art. There is also a short chapter dealing with that part of Colette's biography which is essential to an understanding of her work; her childhood and her first marriage.

Microfilm $3.20; Xerox $11.05. 245 pages.

LORD BYRON AND THE CONCERT OF EUROPE

(L. C. Card No. Mic 61-1928)

Edwin Johnston Maurer, Ph.D.
State University of Iowa, 1961

Chairman: Professor S. Rhodes Dunlap

Byron's political outlook emerged from his Whig inheritance, an aristocratic sense of obligation to the humble, and a rebellious temperament which opposed him to monarchy and made him regard all absolutism as tyrannous. However, he remained too staunch an aristocrat to join the democrats; even when he sympathized with their objectives, demagogues were as hateful to him as kings. He admired reformers and liberators, but his regard for Napoleon was almost idolatrous and remained proof against numerous disappointments when Napoleon proved too thirsty for power.

In Parliament, Byron associated with the anti-war Whigs who promoted Reform, Catholic Emancipation, and the abolition of slavery. In 1812 he made two speeches, the first opposing a bill to make Luddism a capital offense, the second favoring the removal of disabilities against Roman Catholics. At odds with most public and parliamentary opinion, recognizing the impossibility of influencing his immediate hearers, Byron addressed himself instead to the liberal audience outside of Parliament. Sarcastically he accused the Tory ministry of tyranny, stupidity, and incompetence and held it responsible for the war, which he deemed the cause of most of Britain's ills.

The political poems antedating Byron's final departure from England show the same sense of impotence before superior strength but are more sober. Two almost pedagogical motives predominate: a desire to inform the English that England is resented throughout Europe (The Curse of Minerva, Childe Harold) and a desire to offer a "correct" interpretation of political events (Napoleon's defeat is not a vindication of kings but a warning to despots).

The Concert of Europe, developed from agreements signed by the victorious powers in 1814-15, endeavored to conserve the status quo by preventing a military resurgence in France and resisting revolutionary tendencies everywhere. Since the prevailing revolutionary mode was nationalism, the Concert powers were devoted principally to suppressing the nationalistic ambitions of subjugated peoples. Domestically, they practiced repression of constitutional and democratically-oriented movements.

Nationalism became Byron's political lodestar. In England he advocated concessions to Irish nationalism. His earlier sympathy for Spain (occupied by France) and the Greeks (controlled by Turkey) developed after 1816 in Italy into a prolonged lament over Austrian predominance (Ode on Venice, Childe Harold, etc.). The myth-figure whom he found metaphorically expressive of the nationalistic predicament was Prometheus, the beneficent Titan chained by the tyrant Zeus.

Gradually, however, Byron began to adapt to political verse the savage irony of English Bards and his parliamentary speeches--first in a passage in Beppo, then in numerous digressions in Don Juan, and finally in the great satires (The Vision of Judgment, "The Irish Avatar," The Age of Bronze). Concurrently, Prometheus gave way to

Satan, whose style passed through a succession of stages from Miltonic defiance to Mephistophelean mockery. Byron ridiculed monarchs and ministers, assailed Wellington as the "prop" of legitimacy, and excoriated Southey as a renegade and sycophant.

Recognizing the essential identity of all revolutionary movements, Byron was enthusiastic over the Spanish and Italian uprisings of 1820-21, joined the Carbonari, and shared the general dismay when Austria easily crushed the Italian revolts. Between 1821 and 1823, he sustained a literary attack upon the Powers and the conspiracy of hypocrisy which maintained them. With hopes for Italian independence dashed, he immersed himself in the cause of the Greeks, whose revolt had begun in 1821. At Metaxata and Missolonghi in 1823-24 he endeavored to improve the treatment of prisoners by both forces, reconcile rival Greek leaders, and create a public-relations atmosphere that might encourage British loans to the Greeks and discourage intervention in the struggle by the Concert of Europe. Microfilm $4.65; Xerox $16.45. 364 pages.

SHAW AND THE NINETEENTH-CENTURY THEATER

(L. C. Card No. Mic 61-974)

Martin Meisel, Ph.D.
Princeton University, 1960

As his own best critic, Shaw persistently called attention to his relation to the nineteenth-century popular theater. This dissertation is an examination of the plays of George Bernard Shaw in the light of the conventions, modes, techniques and genres of that theater. The procedure of the study is roughly chronological. Of the three major parts, the first, "Dublin Roots," takes up the provincial theater of the sixties and seventies; the second, "London: Currents and Crosscurrents," the metropolitan theater of the eighties and nineties. The third, "Dramatic Genre and the Drama of Ideas," discusses the polyform drama Shaw subsequently created from the nineteenth-century theater and its kinds.

The examination of Shaw's Dublin heritage reveals the stock-company system, the theatrical stereotype, and the nineteenth-century kinship of opera and drama, of the musical and the rhetorical, as integral aspects of his dramaturgy. The examination of his early London experience, and particularly the period of his journalistic criticism, defines Shaw's critical stance towards fashionable developments in acting, drama, and literary theory, which was also the basis of his personal artistic program. The examination of Shaw's dramatic creation in "Dramatic Genre and the Drama of Ideas" reveals a pattern of resemblances to groups of nineteenth-century plays, where a certain subject matter is characteristically combined with a certain tone and with certain conventions of character, action, and setting. "Dramatic Genre and the Drama of Ideas" attempts to define a series of such play-groups, many of which have passed from the stage, and to show their fundamental significance in Shaw's work.

There are two significant patterns which emerge from Shaw's exploitation of nineteenth-century "genre." First, there was an evolution through Shaw's playwrighting career from a more or less doctrinaire "realism" to a more or less spontaneous fantasy, from the plays classed as "Unpleasant" to the final "Extravaganzas." Second, there was a successsion of three major modes of the "Drama of Ideas," from Melodrama, to Discussion, to Extravaganza; modes generated from the three major forms of the nineteenth-century drama, Melodrama, Farce, and Extravaganza.

The beginning of this study raises the question of Shaw's relation to the rhetorical tradition of English drama, to the "artificial high horses" of the nineteenth century and to the literarily pretentious five-act tragedy of the passions in blank verse. The conclusion of the study suggests that Shaw's place in the mainstream of English dramatic history may be defined, on the one hand, by his turn to popular drama for the conventions and materials of his serious dramatic art, and on the other, by his conversion of an inherited dramatic rhetoric of the passions to a rhetorical drama of ideas.

Microfilm $8.90; Xerox $31.60. 702 pages.

POE'S GRAND DESIGN: A STUDY OF THEME AND UNITY IN THE TALES.

(L. C Card No. Mic 61-1482)

Stephen LeRoy Mooney, Ed.D.
The University of Tennessee, 1960

Major Professor: Philip G. Smith

Two general conclusions may be drawn from the present study. The first concerns the extensive features of Poe's Grand Design, and the second concerns intensive features. First, the extensive: Theme and unity are mutually reinforced by the variety of kinds which Poe exhibits in the tales; degradation and destruction are constant thematic factors in comedies, tales of secret crime, tales of ratiocination, occult tales, and philosophic tales. And second, the intensive: Theme and unity are given literary depth by the repetition of motifs classifiable under the heads of competing, cutting and dividing, enclosing, and traveling, all of which Poe embodies in a spectrum of effects ranging from the burlesque to the mystical, chiefly Gothic in quality and serio-comic intention. Both intensive and extensive features, taken together, result in an image of nineteenth century man in America which has influenced world literature in the twentieth century. The Grand Design, then, may be construed as the Folio Club scheme magnified, to include extensions and developments of the early tales, and unified by the repetition of motifs and by a steady thematic continuity that runs throughout the fiction.

The major theme of the tales is that man's tendency to self-destructive mental states is the source of his social, intellectual, and moral failure and may culminate, indeed, in actual catastrophe for the earth that he controls. The Folio Club plan is the earliest manifestation of the theme. The frame-story design of the club is an architectonic creation of an author-deity who pretends to have been excluded from all proceedings up to the time of his admission as a member; his "discovery" that the fraternity is

"diabolical" causes him to make his exposé and to bring the scheme to an end: at once a constructive and a destructive act that was planned from the beginning. The Folio scheme continues to operate in Poe's work through the repetition of themes and motifs first introduced in the early tales. The theme of man's violence and brutal debasement runs steadily throughout the later tales, culminating in the destruction of the world as it is explained in the philosophic tales. Eureka, though not a work of fiction, is associated with the fiction through comic interpolations that refer thematically to Folio Club and later materials.

The whole of Poe's tales is a unified comédie humaine descriptive of American life and literary taste in the early nineteenth century, with ramifications of meaning still vital in the present day. The major theme is expressed in the interplay between democratic and aristocratic forces. Democracy at its worst was mobocracy, toward which Poe's attitude in the tales is frequently one of distaste. The supreme aristocrat was God. On earth His counterpart was the Artist, the Maker, the Poet, the Participator in cosmic understanding, and the Creator of universes of words. The theme of democracy is linked with that of man's potentiality: Man was granted the capability of being a type of God, but his powers have been leveled down in the political system of equality among men upon which America was based. Thus democratic man presented the grotesque spectacle of potential divinity descending into the most ludicrous extremes of human fallibility. The fact that this view appears in the tales under elaborate disguises of character and setting (regal personages, opulent Oriental palaces) does not remove it from the American scene, nor diminish its seriousness, even when the presentation is most farcical. Poe's purpose in all his work was to create an effective design: His handling of themes and motifs in the individual tale brings about the hidden book-unity that informs the fiction as a whole. Microfilm $2.75; Xerox $9.45. 209 pages.

PROTESTANT MINISTERS IN MODERN AMERICAN NOVELS, 1927-1958: THE SEARCH FOR A ROLE.

(L. C. Card No. Mic 61-1972)

Walter Earnest Mueller, Ph.D.
The University of Nebraska, 1961

Adviser: Walter F. Wright

Since the late twenties, when Elmer Gantry appeared as their most notorious representative, the Protestant ministers depicted in American novels can lay common claim to the title "the lost generation," which Gertrude Stein first gave to certain writers (and presumably also to their created characters). The lostness of ministers in fiction reflects the lostness of the real-life ministry, which H. Richard Niebuhr has called the perplexed profession.

Although Elmer Gantry was – and is – regarded by many as a mere caricature, he was only one among many lost fictional heroes, such as Frederic Henry, Eugene Gant, Caddy Compson, and Jay Gatsby, all of whom appeared on the published page within a period of five years.

Seen from another point of view, lostness manifests itself as the spirit of searching and as such belongs to the normal state of the Protestant minister, real or fictional, for the "Protestant principle" requires that existing statements of truth be perpetually challenged as being incomplete.

A significant distinction can be made between the minister who is aware of his lostness and the minister who is stolidly unaware. Some ministers, even while conducting ineffective ministries, manifest little awareness of lostness but remain full of assurance, an assurance based on well-learned rituals, on verbal propositions, or on romantic symbols unrelated to physical reality. On the other hand, many ministers feel great concern and experiment with various methods for resolving their uncertainty.

Most authors apparently believe that to undertake direct probings of the abstractions of idealism and theology is foreign to the art of fiction. Indirectly, however, the novels testify that at the root of lostness is the inability of ministers to make a wholeness out of the elements of ideality, symbols, and sensory reality. Vaguely sensing the fragmentation of their world, ministers and parishioners are engaged in largely unconscious attempts to level God, ideality, man, ministers, symbols, rituals, and everyday reality to one common and often monotonous plane. In so doing they substitute "sameness" for "oneness." Some of the marks of the attempt to level the elements of religion are the hesitancy to use the word God, the eagerness to elevate the ministry to godhood, the portrayals of ministers as "just one of the gang," and the metamorphosis of sensuality into a ritual.

Several historical novels of the thirties deal more directly with theological theory. In their search in the past for the causes of the maladies of today, the authors discover both the desirable certainty and undesirable rigidity of Calvinism.

Since to make direct probings of ideality is perhaps foreign to the art of the novel, ideality must be viewed as it coalesces with and is absorbed into the physical. Accordingly, the physical world is a major concern of all novels. Ministers experiment with sensuality and physical pleasure but reject them as a way out of lostness. Suffering offers more suitable material, and the novels under consideration shed new light on the religious meaning of pain. Novels are concerned with attempts to bring the world of the medical doctor and the world of the minister together.

The unique contribution of novels to the relentless quest for meaning is the result of the power of the art of fiction to present situations in their wholeness. The concrete world of fiction can present the wholeness of life by fusing the elements of ideality, symbol, and reality. A number of novels succeed in presenting individual scenes of wholeness, where for a moment lostness comes to an end.

Microfilm $6.85; Xerox $24.30. 538 pages.

THE CRITICAL RECEPTION OF AMERICAN FICTION IN THE NETHERLANDS, 1900-1953.

(L. C. Card No. Mic 61-1773)

Peter Oppewall, Ph.D.
University of Michigan, 1961

The purpose of this study is to measure and evaluate the critical response to contemporary American novelists in the Netherlands as revealed in reviews, articles, essays, and literary histories, and to compare this with popular response as recorded in the number of their works translated and editions published.

The reception of American fiction in Holland was slight during the first two decades of the twentieth century. It began to increase in the middle and late 'twenties, and swelled to a pre-World War II peak in 1930. The response was moderate throughout the 'thirties, but came back stronger than ever immediately after World War II. Virtually full acceptance by the Dutch of American writing has come during the post-War II period.

The greatest motivation for the Dutch in the reading of American fiction has been curiosity about our way of life. Social critics like Upton Sinclair and Sinclair Lewis have had by far the greatest vogue in the Netherlands of all our writers. Dutch readers came at first to confirm their prejudice that the United States was a materialistic and culturally immature country. For a time the Dutch seriously overestimated the literary achievements of our social critics and accepted the most exaggerated portrayals as true pictures of life in America. Although the literary weaknesses of these writers were soon discovered, the extreme nature of their criticism was not generally understood.

Our naturalistic writers have also had considerable vogue in the Netherlands. They were read primarily for their implied social criticism and for the detailed picture they gave of American life rather than for their naturalistic philosophy. They were severely criticized for spiritual inadequacy and narrowness of vision.

More restrained but nevertheless substantial interest has also been shown in Holland in our social realists--writers who depicted life in particular sections of the country, or in certain areas of our society. This response demonstrated that Dutch acceptance of our fiction was not limited to negative or hostile portrayals of life in the United States.

The Dutch were able to transcend their prejudices and special interests in the case of our two greatest contemporary novelists, Ernest Hemingway and William Faulkner. They received Hemingway in 1927 and followed all his work with interest. To an even greater extent they were aware of the genius of William Faulkner, and their "discovery" of him paralleled his reception in France. The Dutch preferred Faulkner to Hemingway because they recognized in him a more positive moral commitment and greater social relevance.

The Negro problem and the Wild West are two unique themes in American fiction which have always compelled attention in the Netherlands. Expatriates have also received more than their share of attention because they were close at hand and were often critical of the United States. The work of American Negro writers and expatriates has sometimes been overrated because of intense Dutch interest in what they had to say.

Post-World War II reception of American fiction in the Netherlands differs from that of pre-War II in that most of the earlier prejudices and stereotypes of Dutch readers are gone. The fiction-derived image of America in Holland is becoming clearer, though it is still occasionally blurred and distorted. Reception no longer is limited to a few magazines and newspapers, but is carried out on nearly all levels of Dutch journalism. Response to American fiction previously depended on a small circle of ardent defenders, but it is now received with approval by leading critics as well as the general reading public, and is frequently ranked with the greatest literature in the world. Microfilm $4.30; Xerox $15.10. 334 pages.

A PALEOGRAPHIC AND ANNOTATED EDITION OF LOPE DE VEGA'S DON LOPE DE CARDONA

(L. C. Card No. Mic 61-1549)

Alvin Hugo Pianca, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Mack Singleton

This paleographic and annotated edition of Don Lope de Cardona has been prepared from MS Number 17417 in the section of manuscripts of the Biblioteca Nacional, Madrid, Spain.

An examination of Emilio Cotarelo y Mori's modern edition of this play in Vol. IV of Obras de Lope de Vega, published by the Spanish Academy (new edition, Madrid, 1917), discloses a number of differences in the transcription and interpretation of the text. In view of this, an attempt has been made to present a faithful transcription of MS 17417, comparing it carefully with Cotarelo's edition. The Notes include the variants found in the Spanish Academy edition, clarification of obscurities in the text and a record of the grammatical errors and lapses that appear in the manuscript.

The spelling has been left unchanged, but in order to present the manuscript in readable form, the words that run together have been separated in accordance with modern orthography. Modern punctuation and capitalization have been adopted and obvious careless errors corrected. No division into scenes has been made.

The text is preceded by a description of the manuscript and some orthographical observations, a discussion of sources, structure, versification and characters, and a synopsis and critical evaluation.

Microfilm $6.70; Xerox $23.65. 525 pages.

THE CREPUSCULARISM OF GUIDO GOZZANO

(L. C. Card No. Mic 61-1581)

Carlo Prisco, Ph.D
Fordham University, 1961

Mentor: Professor Victor R. Yanitelli, S. J.

Crepuscularism arose in the first decade of the twentieth century as part of the decadentistic literary movement of Italy. It was a reaction to the heroics and sensualism of D'Annunzio and the power and grandeur of Carducci. The crepuscolari preferred the vague light of dusk to delve into the twilight zone of their sentiments. Disillusioned with the world and its pragmatic ideals they withdrew to the small and comforting atmosphere of their home and of their province. There they sang in a modest voice of the petty things which made up their everyday life, mourned over the irrevocable past, and pined away after dreams impossible of fulfillment. These crepuscular poets looked at the unresolved conflicts within themselves with an attitude of subtle criticism and irony. The initiator of crepuscularism was the poet Sergio Corazzini and its most outstanding exponent was Guido Gozzano.

Gozzano was born in Turin in 1883. His life and work were closely influenced by his native city and by the town of Agliè Canavese in the region of Val d'Aosta. The dissolute life he led while attending the University of Turin as a law student ruined both his health and his spirit. In 1904 he contracted the tuberculosis which was to plague him the rest of his life and bring about his death in 1916. He also became imbued with a pagan and pessimistic outlook on life, following in the footsteps of Nietzsche and Schopenhauer.

In 1907 he published his first book of poems, La via del rifugio, which was very successful. This book was the cause also of a lifelong personal and epistolary relationship with the poetess Amalia Guglielminetti. She became the outstanding example of his inability to fall in love with a woman and become completely absorbed by such a love.

In 1910 he published his second volume of verse, I colloqui, less sceptical in tone than the first and foreshadowing the spiritual crisis which was to beset him. In 1912 he made a trip to India which resulted in his travel book Verso la cuna del mondo. The outbreak of the First World War and the onslaughts of his illness made him turn definitely toward God. Shortly before his death he returned to the Faith.

The crepuscular traits of perplexity and indecisiveness are evident in Gozzano's poetry. The perpetual unresolved conflict between intellect and emotion is seen especially in the poems "La via del rifugio," "L'ultima rinunzia," "Invernale," and "Totò Merùmeni." Characteristic feelings of indifference, indolence, vacillation, and futility permeate many of his poems.

Gozzano's nostalgic love of the past and the yearning for his province are evinced in his poetic masterpieces "L'amica di Nonna Speranza" and "La signorina Felicita," as well as in "Cocotte" and the long entomological poem "Le farfalle." Regret for his lost youth and health come to the fore in the opening and closing verses of I colloqui and in his famous poem "Le due strade."

The vanity and futility of all human endeavor is the dominant thought in Gozzano's major prose work, Verso la cuna del mondo. Crepuscular motifs are also found in many of his short stories and articles, and in his collection of fairy tales and poems for children.

The underlying theme of Gozzano's art is the twin goal of "refuge-flight": the unceasing search for shelter and protection from the world, and the repeated escape to seek new horizons. His poetry, even though sung in a minor key, is of lasting value because it portrays with a disarming sincerity and delicate artistry the travail and barrenness of his soul.

Microfilm $2.75; Xerox $9.00. 196 pages.

MERCIFUL DAYS

(L. C. Card No. Mic 61-1934)

Thomas Hunton Rogers, Ph.D.
State University of Iowa, 1961

Chairman: Assistant Professor Donald R. Justice

Merciful Days begins at Harvard. The opening section, "Gaudeamus Igitur," is a derisive picture of Harvard life, culminating in a farcical graduation ceremony and the departure of the young hero, Paul Zybargus. The rest of the novel deals with Zybargus' establishment in life.

In the second section Zybargus is in Washington. He talks his way into the confidence of Senator Phipp and together he and the Senator concoct an investigation of the great foundations. The grounds are that foundation grants disrupt the unity and detract from the independence of college faculties. Their argument is that this results in sabotage of American intellectual resources. The Senator has been hunting for just such a statesmanlike-sounding issue. The investigation, however, fails to arouse much interest; the Senator begins to lose his enthusiasm and Zybargus finds that his position of influence is undermined.

One of the few effects of the investigation is that the Arbuckle Foundation cuts down its grant to Professor Amos McChesney of Harvard. Phipp had singled out the professor's study of the Concept and Practice of Mercy as a particularly flagrant example of the way foundations encourage unprofitable use of the nation's intellectual resources. "Alma Mater," the third section of the novel, takes place in Washington and Cambridge. Professor McChesney counterattacks Phipp by secretly persecuting the Senator's son, a freshman at Harvard. Phipp sends Zybargus to investigate this mysterious situation. Zybargus more or less accidentally discovers McChesney's plots; as the price for this information, he extorts a better job from the Senator.

McChesney is a Canadian citizen whose residence qualifications are not quite perfect. Phipp thus succeeds in expelling him from the United States. The fourth section of the novel deals with McChesney's attempts to retaliate, and with Zybargus' increasing distance from Phipp. In Canada McChesney starts writing open letters to Phipp's constituents. In the United States, Zybargus makes contact with a representative of the Consolidated Oil Company. Consolidated Oil wants Phipp to back a canal that will save them shipping costs, and Zybargus promises to put to use in their interests his now largely imaginary influence on the Senator. Phipp, threatened by McChesney and betrayed

by Zybargus, reacts with his usual mixture of ambiguity and decisiveness. He manages to get the Canadian government to enjoin McChesney's letter writing, while he blandly stalls Zybargus' new attempts to manipulate him. McChesney, driven slightly mad by his misfortunes, decides to assassinate the Senator. Zybargus promises Consolidated Oil that Phipp will back the canal.

The fifth section of the novel takes place at a fancy dress ball in Washington. McChesney appears and stalks the Senator until he finds an opportunity to murder him. Zybargus, who recognizes McChesney under his slim disguise, does nothing to warn Phipp. In fact after the murder Zybargus helps McChesney to escape. In the Epilogue Zybargus is hired by Consolidated Oil and McChesney is eventually readmitted to the United States. He settles down at Harvard to finish up his study of the Concept and Practice of Mercy.

Microfilm $3.20; Xerox $11.25. 246 pages.

STUDIES FOR A DEFINITIVE EDITION OF HENRY JAMES'S THE SPOILS OF POYNTON. (VOLUMES ONE AND TWO.)

(L. C. Card No. Mic 60-6460)

Stanford Patrick Rosenbaum, Ph.D.
Cornell University, 1960

The widespread attention that has been given to the art of Henry James has not yet produced the definitive editions of his works that are needed for responsibly informed literary criticism. The purpose of these studies is to prepare one of James's works -- The Spoils of Poynton -- for such an edition by examining the sources and origins of the novel, by summarizing and evaluating the extensive notebook entries in which James planned the Spoils, by collating the four texts of the novel and discussing the three sets of revisions that James made, and finally by analyzing the preface to the New York Edition of the Spoils.

The famous account of the origins of the novel given by James in his preface to the Spoils is corrected and amplified by his notebooks and by at least two other sources that he does not mention. More important, however, is the influence of the dramatic years and the "divine principle of the scenario" through which James planned his novel and accomplished the transition from his plays to his later fiction.

The nearly ten thousand words of notebook entries on the Spoils show how James failed to keep a projected short story from growing into a novel and how he succeeded in planning the novel through the climactic structure of the well-made play. In seeking what he called "scenic intensity" James arrived at the moral ideas in his novel, but the pursuit of this intensity involved a radical shift of his original interest in the "germ" of his story.

The serial form of the Spoils did not obscure the scenic structure of the novel, although it did impose some undesirable conditions. The first American and English editions of the Spoils, published within a week of each other, both show more than twelve hundred revisions of the serial, and they range in importance from the deletion of commas to a change of the title. There are also nearly six hundred variant readings between the first editions themselves. A collation of these texts reveals that within six months James revised his novel from the serial to the first American edition and then from the first American edition to the first English edition. The first revision entailed many changes in syntax and punctuation as well as a few corrections of errors in the story; the second revision applied the principles of the first revision more consistently.

The Spoils was again minutely revised for the New York Edition. This time James substituted an "immense array of terms, perceptional and expressional," and continued to make the descriptive details of his novel more specific. These changes are not as extensive or controversial as those James made in his earlier works, but they are significant enough to make the New York Edition the best of the four texts of the novel. In his preface James introduced the novel rather than exhaustively criticising it, and his comments on Fleda Vetch and on the center of the novel -- which is also emphasized in the frontispiece -- all suggest where criticism of the Spoils can most profitably begin.

A complete collation, keyed to the text of the New York Edition, of the more than three thousand changes made by James in his three revisions is presented by itself. This collation, the notebooks, and the preface are the principal "documents" on the novel. Their relevance to a full understanding of the Spoils is discussed in the conclusions that are drawn from these studies. For the most part, critics interpreting the novel have not been aware of the usefulness of these documents. A wider value of these studies is to be found in their analogous significance for James's other works which can also be illuminated from what is known about The Spoils of Poynton.

Microfilm $4.95; Xerox $17.55. 386 pages.

THE INFLUENCE OF SCIENTIFIC AND SOCIO-SCIENTIFIC IDEOLOGIES ON SOME EXAMPLES OF THE MODERN AMERICAN POPULAR NOVEL

(L. C. Card No. Mic 60-6944)

Virginia Adelia Koons van Benschoten, Ph.D.
University of Michigan, 1960

This study deals with the influence of scientific and socio-scientific ideologies on the modern American popular novel during, roughly, the first half of the Twentieth Century. The study is based on the theory that the popular literature of a period to some extent reflects the conventions and attitudes of its readers. Therefore, in the books that have sold the most widely, the novels, one should find some reflection of any extensive change in the generally accepted beliefs of their readers. Popular literature is defined herein as that literature which is written with little artistry and is widely read, and the popularized scientific and socio-scientific theories which are dealt with as influencing the post-World War One popular literature include Darwinism, Marxism, Freudianism, and other psychological and sociological theories and experiments.

Post-War I popular fiction must be compared with its pre-War counterpart, and as it is impossible to examine carefully even the bulk of the best selling novels, a sampling

method is necessary. A choice was made, based primarily on popularity, of a novel from each period of the three best selling types, the detective, sentimental, and historical novels. The pre-War novels so selected are carefully compared as to plot, characterization, setting and style, with the post-War novels; Mary Roberts Rinehart's The Circular Staircase with Dashiell Hammett's The Maltese Falcon; Harold Bell Wright's The Shepherd of the Hills with Lloyd Douglas' Disputed Passage; Mary Johnston's To Have and To Hold with Samuel Shellabarger's Lord Vanity. In this comparison an attempt is made to determine the attitudes and mores which influenced the books, attitudes apparently accepted by the public which made them best-sellers, and either accepted by their authors or assumed by them to please their publics.

A comparison of the ideology of these examples shows the plots of the pre-War novels to be strongly influenced by class consciousness, and the authors to have either accepted or assumed considerable race bias. The plots of the post-War novels stress the desirability of conformity to one's society and are free from class consciousness and race bias. More predictably, the post-War novels show a sex freedom in sympathetic characters not exhibited even by villains in the pre-War novels. A comparison of the authors' techniques shows that the post-War authors attempted a greater realism in characterization, setting and style. These changes seem to have been due, in part, to the general acceptance of the various scientific and socio-scientific theories which were popularized in America after World War One, even the apparently increased realism in style possibly having been influenced by the pre-eminence of science after the War, the "realistic" style, as defined, bearing some resemblance to the scientific method. Other novels of the periods and types, more briefly examined, show, on the whole, the same changes, those of the authors who were best sellers both before and after the War changing in conformity with these changes in popular ideology.

Although the purpose of this study is not to evaluate the literary merit of the best-sellers, most of their critics devote themselves to this question, agreeing that there has been great improvement therein during the century. An examination of some of this criticism in the light of the conclusions reached in this study leads to the further conclusion that the apparent improvement in the post-War best-sellers may be due to the acceptance by the critics of the mores and attitudes accepted by the best-seller public, attitudes which were influenced by the popularized science and socio-science, and not necessarily leading either to better philosophy or improved literary quality in the novels. Microfilm $3.30; Xerox $11.50. 253 pages.

THE INVISIBLE WORLD OF THE SCARLET LETTER

(L. C. Card No. Mic 61-1808)

Robert Emmet Whelan, Jr., Ph.D.
University of Michigan, 1961

The Scarlet Letter, although Hawthorne's most popular romance, is still evoking conflicting interpretations. Still it does not seem possible that Hawthorne, who had always been a careful craftsman, would have written an obscure book in his maturity, unless he purposely wished to mystify his readers. This, however, does not seem to have been his intention; for he stated the contrary in his preface to Twice-Told Tales: "Every sentence, so far as it embodies thought and sensibility, may be understood by and felt by anybody who will give himself the trouble to read it, and will take up the book in a proper mood." It may be that the doors to Hawthorne's deeper meanings have been to some extent closed by the modern reader's lack of familiarity with allegorical techniques and methods: a failure to recognize the symbolic pointers and personages in which the writings of Hawthorne abound, would be a probable source of those obscurities and ambiguities which critic after critic has found in The Scarlet Letter. Pearl and Chillingworth, whom many critics have called incomplete and unreal, seem to have been the occasion of many of the difficulties that puzzle readers. Hawthorne may well have intended such unreality and incompleteness as artistically necessary to the creation of allegorical personifications. Of late, to be sure, much interpretation of The Scarlet Letter has stressed the symbolic aspect of both Pearl and Chillingworth; but there has been little agreement about what the child and the vengeful husband personify.

The general purpose of this study has been to show that The Scarlet Letter is allegorically and symbolically far more complex than is generally recognized; its more specific purpose has been to define accurately the allegorical roles of Pearl and Chillingworth. The method has been a very close analysis of scene, incident, character, and dialogue. It was found that Hawthorne was making masterful use of allegorical techniques which he had already long practised in his earlier writing. Short stories and sketches, such as "The Antique Ring," "Egotism; or, The Bosom Serpent," "Young Goodman Brown," "The Haunted Mind," and "Monsieur du Miroir" proved to be valuable commentaries on Pearl and Chillingworth. Indeed "The Haunted Mind" and "Monsieur du Miroir" contained almost all the elements which went into the making of Chillingworth's role and character. These early works also clearly revealed Hawthorne's propensity to transform people and things into magic mirrors that bestow form and color on the invisible movements of the soul.

The major conclusion of our study is that Hawthorne deliberately surrounded Pearl and Chillingworth with a preternatural atmosphere in order that they might the more easily reflect the inner lives of Hester and Dimmesdale. According to our analysis almost every word and action of Pearl and Chillingworth serves either to emphasize or to reveal some character trait or some psychological development in Hester or Arthur. Part of Chillingworth's complex role is to personify the minister's

remorse, cowardice, hypocrisy, and morbid introspection, while Pearl shows herself to be the incarnation of Hester's love for the minister as well as the spokesman for her mother's conscience. This study also suggests that Chillingworth at times dramatizes Hester's thoughts about Dimmesdale. Moreover, the words of Pearl and Roger often reveal themselves as ironically prophetic of the fate that was growing between Hester and the minister. Some other results of our analysis are that Chillingworth's discovery of the scarlet letter on Dimmesdale's breast represents a self-discovery on Dimmesdale's part; that Dimmesdale's catching sight of Chillingworth's malignant features under the light of the meteor is another moment of self-recognition for the minister; and that Chillingworth's last will and testament symbolizes Dimmesdale's last heroic appearance on the scaffold.

Microfilm $3.50; Xerox $12.15. 270 pages.

REALITY AND WYNDHAM LEWIS'S THEORY OF FICTION

(L. C. Card No. Mic 61-1809)

Dallas Eugene Wiebe, Ph.D.
University of Michigan, 1961

This study attempts to present a unified view of Wyndham Lewis's theory of fiction. To achieve that purpose, Lewis's fiction is discussed in terms of what was for him a lifelong concern, a definition of reality. That attempt to define reality is presented as the central principle of his theory of fiction. However, in order to focus the discussion, special attention is paid to his attempt to define the reality of character. For, it is argued, character is the central concern of Lewis's fiction. And the reality of character is the reality of kinds of mind, especially as kinds of mind are formed by received ideas. Thus, when received kinds of mind, especially those formulated by a Zeitgeist, determine the fate of an individual, what that fate turns out to be is what Lewis calls the reality of that kind of mind. In addition, it is argued that the implications of any one kind of mind are what Lewis meant by "metaphysical dimensions." Metaphysical dimensions are what a kind of mind causes to happen to an individual in any one area of activity.

This study is organized in terms of Lewis's preoccupation with a definition of reality by means of his fiction. Chapter one, "Reality in the Polemics of Wyndham Lewis," aligns Lewis's polemics around the problem of reality and shows how that problem gives coherence to his thought. Chapter two, "Politics and the Novel: Tarr," presents a discussion of Lewis's first novel in which he works out his concept of the reality of kinds of mind. Chapter three, "The Revenge for Love: Machtpolitik and Victorian Romance," discusses how Lewis defines the reality of kinds of mind in terms of contemporary politics. Chapter four, "The Vulgar Streak: The Unreal Mind of the Man of Action," treats the novel in which Lewis finds in a single instance of a kind of mind the destiny of a nation. Chapter five, "Self Condemned: The Doom of the Good European," is a discussion of the novel in which Lewis tests the validity of that kind of mind which he presented as a prescription for health, the mind of Western man.

This dissertation concludes that Lewis's theory of fiction is, in fact, organized around an attempt to define reality. And that definition is effected in and through fiction by letting ideas, especially received ideas, determine action. Lewis's fiction is, then, a method of evaluating those received ideas. For Lewis, the best definition of the reality of a person's kind of mind is to let that kind of mind determine the course of events. Where it leads its bearer is its reality. In addition, although other aspects of Lewis's theory of fiction are not discussed, it is also suggested that every aspect of hiw way of writing is determined by his concern for a specific definition of reality. It is, then, in terms of his attempt to define reality that one may best arrive at an understanding of his theory of fiction. And it is that search for reality that guarantees the value, energy and unity of Lewis's novels.

Microfilm $3.10; Xerox $10.80. 237 pages.

THE SERTÃO IN THE ROMANCES OF FOUR BRAZILIAN WRITERS: JOSÉ DE ALENCAR, BERNARDO GUIMARÃES, FRANKLIN TÁVORA AND ALFREDO D'ESCRAGNOLLE TAUNAY.

(L. C. Card No. Mic 60-6196)

Norman Winkler, Ph.D.
University of Pittsburgh, 1960

This dissertation is a study of the sertão or backlands of Brazil in the novels of four nineteenth-century Brazilian writers. Through the description of the land and the traditions and traits of character of the sertanejo their romances present a picture of a way of life in a rural, patriarchal slave-owning society that had persisted from the Period of Discovery until the end of the nineteenth century. Although these writers are generally grouped together as belonging to the romantic school, their treatment of the sertão and the sertanejo vary from subjective romanticism in Alencar to various degrees of realism in Taunay and Távora. These writers in their literary works are major figures in the development, after the Independence, of a Brazilian national literature as differentiated from that of Portugal. In casting off Portuguese hegemony over Brazilian literature and in creating a national literature these four writers fill the same rôles as do Cooper, Poe, Emerson, and Thoreau in American literature. The regionalism of the romances sertanejos of these four writers has continuity and reaches a high point in Euclydes da Cunha's Os sertões, and has found significant expression in O Movimento Regionalista do Recife and the novelists of the Northeast who grouped themselves around the sociological writer, Gilberto Freyre.

A discussion of the sentiment of nacionalidade precedes the chapter on Alencar. A chapter is devoted to each of the four writers and contains a biographical sketch of the romancista, detailed résumés of the novels under

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

consideration and a critique based on a summary of the criticism of the day, contemporary criticism and the author's observations. The section on Távora, in particular, presents a full-scale perfil literário which deals in turn with each of his major works. The author views him essentially as a man of ideas and has treated at length the question of a literatura do norte and Távora as a literary critic. The treatment here of Távora is the most complete study on this writer (not excluding Brazil) to date. The author has used Brazilian critics and historians almost exclusively to present this aspect of Brazilian life through Brazilian eyes. In numerous appendices there are trechos by the four romancistas as evidence to support his statements.

The author has included Indices das matérias of the Revista Brazileira, Tomos I-X (1879-1881), the period when Távora was editor of the review. These volumes show a wide range of intellectual and investigative activity. They form a valuable source of material on the first publication of major works, poetry and criticism by Machado de Assis and Sílvio Romero among others. In addition to articles by Sílvio Romero on the emancipation of the slaves, A poesia popular no Brazil and critical works which show the development of his História da literatura brasileira, the contents of these volumes reveal him as a poet. Tomo V contains an issue (10 de julho de 1880) of Homenagens to Camões on the tercentenary of his death. These are tributes in verse by leading Brazilian writers of the day. The author has on microfilm almost all the Tavoriana including the ten tomos of the Revista Brazileira. Microfilm $8.00; Xerox $28.35. 630 pages.

FAULTES FAULTS, AND NOTHING ELSE BUT FAULTES BY BARNABY RICH: AN EDITION WITH INTRODUCTION AND NOTES.

(L. C. Card No. Mic 61-1813)

Melvin Herbert Wolf, Ph.D.
University of Michigan, 1961

This edition is a facsimile of the first and only previous edition of Faultes Faults, and Nothing Else but Faultes, which appeared in 1606. The xerographic reproduction of the text is from a copy in the Henry E. Huntington Library.

The life and works of Barnaby Rich are treated at some length in the Introduction. What is known of Rich's life is documented in a single chronological listing; that chronology serves as the basis for the narrative account that opens the Introduction. The descriptive bibliography of the earliest extant editions of Rich's printed books corrects or augments the information in the Pollard and Redgrave Short Title Catalogue on the following matters:

1. The STC identifies My Ladies Looking Glasse (1616) as "anr. issue" of Faultes (1606). These are actually separate and distinct works.
2. The STC identifies The Fruites of Long Experience (1604) as "pt. 2" of A Souldiers Wishe to Britons Welfare (1604). These are really two issues of the same work.
3. Since copies of neither appear to have survived, A Martial Conference (1598) and A Looking Glass for Ireland (1599) are not listed in the STC. They are represented here by notices of their existence.

The Introduction also includes a critical evaluation of Faultes, which is shown to display two of the essential characteristics of good literature--it delights and it instructs. The book's aesthetic value lies in its "Baroque" style, its satiric tone and form, and its more than twenty Overburian Character sketches (these last appearing some eight years before the first Overbury collection). The book's usefulness derives partly from the lasting validity of its moral strictures, but especially from its ability to convey to a modern reader an image or reflection of its own age.

The textual and explanatory notes are addressed to the interested but inexpert reader in Elizabethan and Stuart literature. Wherever possible Rich's immediate sources have been identified, his classical and biblical quotations and allusions verified.

Microfilm $3.50; Xerox $12.15. 270 pages.

THE WORLD OF KATHERINE ANNE PORTER

(L. C. Card No. Mic 61-1827)

Lee William Yosha, Ph.D.
University of Michigan, 1961

Katherine Anne Porter has published relatively few works, but these have been hailed universally as among the most consummate examples of craftsmanship in contemporary fiction. Indeed, critics have praised Miss Porter's virtuosity with such intensity that they have obscured the nature and values of her thematic perceptions. The purpose of this study is 1) to examine both the formal and ideological structures of all of Miss Porter's published stories, 2) to so group and relate these stories that Miss Porter's dominant preoccupations may be meaningfully explored, and 3) to arrive at an assessment of her contributions to her art. This assessment considers both the degree of craftsmanship she has achieved and the value of her particular vision.

Miss Porter's stories are concerned with four major themes: the person in conflict with the past (as manifested in the traditions of the old South); the person in conflict with the family; the woman in conflict with a male constructed world; and the person in conflict with 'foreign' attitudes (which Henry James has termed the "international theme").

These themes are discussed in this study in an order which roughly approximates the order in which they affect an individual life history. The Southern stories are attempts to define the shaping powers of the past, to determine the extent to which the past is master over the present, and to arrive at some definition of the past which will render it useful to the present and future.

The family stories view the family relationship as a sort of battleground upon which each person constantly tests his propensity to love and hate. Each story focuses on a specific marriage and explores the effects of that

marriage in terms of its ability to sustain or destroy its component members.

The third group of stories deals with women who are confronted by a world invested with social and moral values designed by the male to gratify the male ego. These are not "feminist" stories, for they neither argue feminist philosophy nor employ the indignant tone of feminist literature. They recognize that a woman, by altering her vision in deference to male authority, is often her own deceiver and betrayer. Miss Porter's central concern in these stories is to describe that aspect of a woman which is particular to her, and which may only be delineated and illuminated by another woman.

The final category is concerned with the "international theme," which James defined as dealing with the bewilderment of the American in the presence of a 'European' order. These stories constitute Miss Porter's attempts to "understand the logic of this majestic and terrible failure of the life of man in the Western world."

These four major themes, and the techniques through which they are imbued with artistic life, are so interrelated that an understanding of them is enhanced by viewing each of them within the total configuration of Miss Porter's work.

The final chapter draws two general conclusions. 1) Miss Porter's contribution to the art of the short story is one of consummation rather than invention. She stands at the apex of a literary period in which the short story has been perhaps the most practiced and productive of all literary genres, and her stories demonstrate the furthest degree to which the techniques of this genre have evolved as the means through which theme may be defined and explored. 2) Her themes originate in the internal world of human proclivities, work through human character, and move outward into the external world of human action. They are concerned, as are no other stories I know, with the strengths and weaknesses of human faculties. Microfilm $3.25; Xerox $11.50. 252 pages.

LIBRARY SCIENCE

A HISTORY AND EVALUATION OF ENGLISH HISTORICAL ANNUALS FOR 1701-1720 AND 1739-1743

(L. C. Card No. Mic 61-1612)

Earl Arwin Forrest, Jr., Ph.D.
University of Illinois, 1961

The purpose is to trace the origin, development, and influence of English historical annuals through 1743, and to evaluate their accuracy and usefulness as historical and reference sources.

It is primarily concerned with four anonymously published accounts of the events of a single year published once a year: 1). A Compleat History of Europe, by David Jones. January 1701 - August 1714; 2). The History of the Reign of Queen Anne, Digested into Annals, by Abel Boyer. March 9, 1702 - April 1713. Commonly known as Annals of Queen Anne; 3). Annals of King George. August 1714 - August 1720 (October 17 for finance). Boyer denied authorship in 1716; Charles Brockwell Jr. may have edited last three volumes; 4) Annals of Europe, by George Gordon. 1739-1743.

To determine why historical annuals originated in England at this time, earlier historical writing, such as annals and chronicles, is briefly discussed and some political and journalistic influences are surveyed. A few similar continental forerunners are listed.

The life and works of each author have been examined for political and personal viewpoints. The method of presentation, arrangement, and indexing of each annual are analyzed.

The contents of the Compleat History and the Annals of Queen Anne are compared with one another and other publications for the following subjects: Parliamentary reporting; trials; religion; military operations; American colonies; deaths, births, marriages, and unusual events; lists of civil and military officials; and royalty. The Annals has a slight advantage in parliamentary reporting, whereas the Compleat History is better for obituaries and civil and military lists. The Annals is more coherent and concise in style.

The two annuals are remarkably similar in selecting and reporting of events. This is due both to copying from one another and use of same sources, such as the monthly Present State of Europe, the London Gazette and other newspapers, news books, broadsides, and pamphlets.

The annuals copied largely from Boyer's monthly Political State of Great Britain from January 1711. The Annals of King George is almost entirely based upon it, but has some additional reporting of ecclesiastical controversies in its final three volumes.

Although the Political State is noted for its original parliamentary reporting, it is chiefly useful today for its lengthy abstracts of political pamphlets. The Historical Register is inferior.

From the monthly chronological account of the Compleat History, the Annals of Europe progressed to a geographical division of domestic and foreign news into chapters with miscellaneous features in a third book. Although its narrative style, and explanatory and interpretative information are superior to that of the preceding annuals, it has very little information that is in neither the London, Gentleman's, nor Scots magazines. It contains a few parliamentary papers and texts of rejected bills not found elsewhere.

Historical and biographical works were searched for

citations. The first annual has seldom been used; the second, often; the third, rarely; the fourth, almost never.

The annalists did little original reporting, but their annuals contain considerable raw materials of history in the form of official documents, letters, and other papers. They are most useful today for reports of obscure events, biography, observations on personalities and events, civil and military lists, and as a general review of the times.

Although they most likely originated from a need for a more orderly account than given by newspapers and periodicals, they influenced the content and form of such periodicals as the Political State, the Gentleman's, London, and Scots magazines.

The annuals and the magazines were precursors of the annual register type. Bibliographies of English and American publications of this type through 1835 are appended. Microfilm $9.20; Xerox $32.65. 725 pages.

TOWARD A METHODOLOGY FOR THE FORMULATION OF OBJECTIVES IN PUBLIC LIBRARIES: AN EMPIRICAL ANALYSIS.

(L. C. Card No. Mic 61-1804)

Paul Wasserman, Ph.D.
University of Michigan, 1961

The purpose of this study is to design and to test a method for eliciting attitudes from the various groups concerned, which public libraries in cities of medium size – 30,000 to 50,000 population – can make use of in the formulation of their goals and objectives.

The analysis grows out of the concern with the difficulties inherent in the measurement and assessment of performance in public organizations in general, and of public libraries in particular. To advance the prospects of such assessments, it is viewed to be necessary for such institutions to have clearly stated goals. Following upon the theoretical bases of this need and the detailing of the concrete barriers to objective formulation in public libraries, a research design is proposed for testing in three different libraries in cities of varying size, varying composition, and varying levels of financial support. The evolution of the ultimate questionnaire and the conduct of the field analyses are described. The course of the investigation is traced through each of the institutions and the results of the survey in each library are assessed.

It is concluded that one condition crucial to the implementation of objectives making use of study findings is a commitment from a library in advance of such analysis to make use of the data and this condition did not prevail during the present analysis. Several hypotheses are advanced: The impetus for specification of goals in any given institution must come from the professional librarians; serious and sustained attention to the problems of objective formulation is highly unlikely in an underfinanced or understaffed Library; and, a complete inventory of complementary programs in the community is essential to an institutional formulation.

The appendixes provide a copy of the general lines of the questionnaire employed and transcripts of interviews with a board member, a librarian, a public official, a community intellectual leader and a "Friend of the Library."

Microfilm $2.75; Xerox $9.45. 207 pages.

FIBER SPACES AND LOOP ACTIONS

(L. C. Card No. Mic 61-1512)

Guy Dante Allaud, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Edward Fadell

The fiber spaces considered in this thesis are of the type defined by W. Hurewicz and were further studied by E. Fadell. Essentially two problems are taken up. The main one is an attempt to classify fiber spaces by means of the loop action. The other problem is less specific and deals with properties that a fiber space inherits from the base and fiber or which the base and fiber inherit from it.

Let $p : E \to B$ be a continuous map, and let B^I be the space of paths with the C-O topology. Define:

$$\Omega_p = \{(e,\omega) \mid p(e) = \omega(0)\ ,\ e \in E,\ \omega \in B^I\}\ .$$

Ω_p is given the relative topology in $E \times B^I$. Let $\tilde{p} : E^I \to \Omega_p$ be given by $\tilde{p}(\alpha) = (\alpha(0), p\alpha)$. The triple $\mathcal{E} = (E,p,B)$ is called a Hurewicz fiber space if there is a continuous map: $\Lambda : \Omega_p \to E^I$ such that $\tilde{p} \circ \Lambda = 1$.

Λ is called a lifting function, B is the base, and $F_b = p^{-1}(b)$ is the fiber over $b (b \in B)$. Usually a base point b_0 is chosen in B and F_{b_0} is called the fiber F.

In the first part of the thesis results of the following type are obtained:

Theorem. Let $\mathcal{E} = (E,p,B)$ be a fiber space. Suppose that E is an ANR and F is weakly locally contractible. Then F_b and $\Omega(B,b_0)$ are ANRs for every b in B.

Theorem. Let $\mathcal{E} = (E,p,B)$ be a fiber space such that F is an ANR and $\Omega(B,b_0)$ is of the same homotopy type as an ANR. Then $\Omega(E,x_0)$ is dominated by an ANR, for any x_0 in F.

Theorem. Let $\mathcal{E} = (E,p,B)$ be a fiber space such that B and all the fibers are ANRs. Then if E is separable metric and finite dimensional it is an ANR.

In the second part of the thesis the loop action is introduced. Let $\varphi : \Omega(B,b_0) \times F \to F$ be the map:

$$\varphi(\beta,x) = \Lambda(x,\beta)(1)\ .$$

Let $\mu_{x_0} : \Omega(B,b_0) \to F$ be the map:

$$\mu_{x_0}(\beta) = \Lambda(x_0,\beta)(1)\ .$$

φ is called the loop action and μ_{x_0} the loop map (at x_0).

Let $\mathcal{E}_1$ and $\mathcal{E}_2$ be fiber spaces over B. φ_1 and φ_2 are said to be conjugate if φ_1 is homotopic to $\bar{g} \circ \varphi_2 \circ (1 \times g)$, where $g : F_1 \leftrightarrows F_2 : \bar{g}$ is a homotopy equivalence. If $F_1 = F_2$ and g is a homeomorphism φ_1 and φ_2 are strongly conjugate.

Conjugate and strongly conjugate loop maps are defined in a similar manner.

Let $\mathcal{E}_1$ and $\mathcal{E}_2$ be fiber spaces over B. $\mathcal{E}_1$ and $\mathcal{E}_2$ are fiber homotopy equivalent, written $\mathcal{E}_1 \overset{f}{\sim} \mathcal{E}_2$, if there exist fiber maps $h : E_1 \leftrightarrows E_2 : k$ such that hk and kh are homotopic to the corresponding identity maps, the homotopies preserving fibers.

The main problem of the thesis is then:

Let $\mathcal{E}_1$ and $\mathcal{E}_2$ be fiber spaces over B which is an ANR. Suppose φ_1 and φ_2 are conjugate. Does it follow that $\mathcal{E}_1 \overset{f}{\sim} \mathcal{E}_2$?

Counter examples were known if B is not an ANR. It is shown that the answer is no even if B is suitably restricted.

Theorem. For every $n \geq 1$ there exists a fiber space

$$\mathcal{E}_n = (E_n, p_n, S^n \times S^n) \text{ such that } \varphi_n(\beta,x) = x\ ,$$

i.e. the loop action is precisely that of a product, but $\mathcal{E}_n$ does not admit a cross section.

Some positive results are the following:

Theorem. Let $B = B_1 \cup B_2$, B a locally finite polyhedron, B_i subpolyhedra contractible in B to b_0. Then any two fiber spaces over B with conjugate loop actions are fiber homotopy equivalent. This parallels results of A. Dold.

Theorem. Let B be arbitrary. If $\mathcal{E}_1$ and $\mathcal{E}_2$ have conjugate loop maps $\pi_i(E_1) \approx \pi_i(E_2)$, $i \geq 2$, and if B is simply connected $\pi_1(E_1) \approx \pi_1(E_2)$.

Given a fiber space $\mathcal{E} = (E,p,B)$ let, for x_0 in F:

$$\Gamma(E,F,x_0) = \{\omega : I \to E \mid \omega(0) = x_0,\ \omega(1) \in F\}$$
$$\tilde{\Gamma}(E,F) = \{\omega : I \to E \mid \omega(0),\ \omega(1) \in F\}$$

Define $\gamma : \Gamma(E,F,x_0) \longrightarrow F$ by : $\gamma(\omega) = \omega(1)$

$$\gamma \times \gamma : \tilde{\Gamma}(E,F) \longrightarrow F \times F \text{ by : } \gamma \times \gamma(\omega) = (\omega(0), \omega(1))$$

The triples $\Gamma(\mathcal{E},x_0) = (\Gamma(E,F,x_0), \gamma, F)$ and $\tilde{\Gamma}(\mathcal{E}) = (\tilde{\Gamma}(E,F), \gamma \times \gamma, F \times F)$ are fiber spaces.

Theorem. Let $\mathcal{E}_1$ and $\mathcal{E}_2$ be fiber spaces over B with a common fiber F which is an ANR. If $\mathcal{E}_1$ and $\mathcal{E}_2$ have strongly conjugate loop maps $\Gamma(\mathcal{E}_1,x_0) \overset{f}{\sim} \Gamma(\mathcal{E}_2,g(x_0))$, and if $\mathcal{E}_1$ and $\mathcal{E}_2$ have strongly conjugate loop actions $\tilde{\Gamma}(\mathcal{E}_1) \overset{f}{\sim} \tilde{\Gamma}(\mathcal{E}_2)$.

Corollary. Suppose $\mathcal{E} = (E,p,B)$ admits a cross section and B and F are simply connected ANRs. Then $\Omega(E)$ is of the same homotopy type as $\Omega(B) \times \Omega(F)$. This is essentially a result of Hu.

The following problem is left open:

If $\mathcal{E}_1$ and $\mathcal{E}_2$ have conjugate loop actions does it follow that E_1 and E_2 are of the same homotopy type?

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For that matter are the singular homology groups of E_1 and E_2 isomorphic?

Microfilm $2.75; Xerox $4.80. 95 pages.

EXISTENCE OF INTERPOLATING FUNCTIONS OF EXPONENTIAL TYPE

(L. C. Card No. Mic 61-1525)

Richard Francis DeMar, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor R. Creighton Buck

Let K be the linear space of all entire functions of exponential type, and let S be the linear space of all sequences $[b_n]$ of complex numbers such that $\limsup |b_n|^{\frac{1}{n}} < \infty$. Let $T:K \to S$ be a linear transformation. If $C \subset K$ and $\gamma \varepsilon S$ and if there exists a function f in C such that $T(f) = \gamma$, then γ is said to be admissible for T and C. If T is univalent on C, then C is called a uniqueness class for T. The problem studied in this thesis is that of finding conditions for the admissibility of a sequence $[b_n]$ in S for a linear transformation T and a subspace C of K where C is a uniqueness class for T.

The main theorem deals with transformations $T = [\mathscr{L}_n]$ having a representation

$$\mathscr{L}_n(f) = \frac{1}{2\pi i} \int_\Gamma [W(\zeta)]^n F(\zeta) d\zeta$$

where $F(\zeta)$ is the Borel (Laplace) transform of f; $W(\zeta)$ is an entire function with $W(0) = 0$ and $W'(0) \neq 0$; and Γ is a simple contour enclosing D(f), the conjugate indicator diagram of f. Let Ω_ζ^* be an open simply connected set containing the origin on which $W(\zeta)$ is regular and univalent and whose image under $W(\zeta)$ is a star set. If C_ζ is a region of the complex plane, let $K[C_\zeta]$ denote the class of functions f such that $D(f) \subseteq C_\zeta$. If $[b_n] \varepsilon S$, let b(z) be defined by $\sum_{n=0}^{\infty} b_n z^n$ and its continuation. The main theorem states:

Let C_ζ be an open convex subset of Ω_ζ^* containing the origin. A sequence $[b_n]$ in S is admissible for T and $K[C_\zeta]$ if and only if b(z) is regular on $\frac{1}{C_w'}$, the image of the complement of C_ζ under the map $t = \frac{1}{W(\zeta)}$.

This theorem is applied to give admissibility theorems for the transformations given by the generalized difference functionals, the Abel functionals, and the generalized Newton functionals. For example, for the sequence $[\Delta^n f(-\frac{n}{2})]$ of Stirling functionals, this theorem is proved.

A sequence $[b_n]$ in S is admissible for the transformation $T = [\Delta^n f(-\frac{n}{2})]$ and the class $K[a,c], c < \pi$, if and only if b(z) is regular on the interval $[-\frac{1}{2}i, \frac{1}{2}i]$ of the imaginary axis.

This result is used to prove a number of theorems concerning implications of the vanishing of certain of the differences $\Delta^{2n} b_{-n}$ for an even sequence $[b_n]_{n=-\infty}^{\infty}$ satisfying a growth restriction. For example:

If an even sequence $[b_n]_{n=-\infty}^{\infty}$ is bounded and $\Delta^{2n} b_{-n} = 0$ for all n belonging to a set of positive integers of density $d \geq \frac{1}{2}$, then $[b_n]$ is a constant sequence.

Similar results are obtained for an odd sequence $[b_n]_{n=-\infty}^{\infty}$.

Some transformations which do not satisfy all of the hypotheses of the main theorem can be dealt with by the same methods. Admissibility theorems are proved for two such transformations--the one given by the Newton-Gauss functionals and the one given by the Lidstone functionals.

A question related to admissibility as defined above is the following: If $C \subseteq K$ and $[p_n(z)]$ is a sequence of functions belonging to K, then, given a sequence $[b_n]$ in S, is there a function f in C such that $f(z) = \sum_{n=0}^{\infty} b_n p_n(z)$, the series being summable by some specified method? This question is discussed for a sequence $[p_n(z)]$ of polynomials satisfying a formal generating relation

$$A(w)e^{zg(w)} = \sum_{n=0}^{\infty} p_n(z) w^n$$

for functions A(w) and g(w) regular at the origin and suitable subspaces $K[C_\zeta]$ of K.

Microfilm $2.75; Xerox $4.20. 79 pages.

CONCENTRIC TORI IN THE THREE-SPHERE

(L. C. Card No. Mic 61-1477)

Charles Henry Edwards, Jr., Ph.D.
The University of Tennessee, 1960

Major Professor: O. G. Harrold

A torus is the topological product of two circles, while a solid torus is the topological product of a circle and a disk. Two solid tori B_1 and B_2 in the three-sphere S^3, with B_2 interior to B_1, are said to be concentric if and only if the closure of $B_1 - B_2$ is homeomorphic to the topological product of a torus and a closed interval. Two tori in S^3 are concentric if and only if they are respectively the boundaries of two concentric solid tori.

If the polyhedral solid torus B_2 is interior to the polyhedral solid torus B_1, then the order of B_1 with respect to B_2 is defined to be the minimal number of points of intersection of a center line of B_2 with a meridianal disk of B_1. The two solid tori B_1 and B_2 in S^3 are said to be equivalently knotted if and only if there exists an orientation-preserving semilinear homeomorphism of S^3 onto itself carrying a center line of B_1 onto a center line of B_2. The relationship of concentricity for polyhedral solid tori is characterized by proving that two polyhedral solid tori B_1 and B_2 in S^3, with $B_2 \subset \text{Int } B_1$, are concentric if and only if they are equivalently knotted and the order of B_1 with respect to B_2 is unity.

This characterization of concentricity is used to determine conditions under which a sequence $\{B_n\}_0^\infty$ of polyhedral solid tori has the property that there exists an integer N such that B_i and B_j are concentric whenever $i > j \geqq N$. It is proved, for instance, that the sequence has this property if $B_0 = \bigcap_{n=1}^{\infty} B_n$ and $B_{n+1} \subset \text{Int } B_n$ for $n = 1, 2, ---$.

These results are used to prove the principal theorem of this thesis, to the effect that the 3-sphere does not contain an uncountable collection of mutually disjoint tori, no two of which are concentric. Results of G. T. Whyburn on non-separated cuttings of connected spaces are applied to show that, if G is an uncountable collection of mutually disjoint tori in S^3, then there is a sequence $\{T_n\}_0^\infty$ of elements of G and a sequence $\{B_n\}_0^\infty$ of solid tori such that T_n is the boundary of B_n and such that $B_0 = \bigcap_{n=1}^{\infty} B_n$ with $B_{n+1} \subset \text{Int } B_n$ for $n = 1, 2, ---$. A theorem of R. H. Bing is then employed to find a homeomorphism f of S^3 onto itself which carries each of the solid tori $\{B_n\}$ onto a polyhedral set. An application of the theorem quoted in the previous paragraph then yields the desired conclusion.

A generalization of the relation of concentricity is then investigated. Two polyhedral solid tori B_1 and B_2 in S^3 are said to be equivalently situated if and only if there is a polyhedral solid torus B which is interior to both B_1 and B_2 and is concentric with each. If B_1 is interior to B_2, then the tori B_1 and B_2 are equivalently situated if and only if they are concentric. It is proved that, if $\{B_n\}_1^\infty$ is a sequence of polyhedral solid tori converging homeomorphically to the polyhedral solid torus B, then there is an integer N such that B_n and B are equivalently situated for $n \geqq N$.

Finally some concepts involving concentric tori are used to obtain a new characterization of tame simple closed curves in S^3. The simple closed curve J is said to have the concentral enclosure property if and only if there is a decreasing sequence of concentric polyhedral solid tori intersecting in J. It is shown that a simple closed curve in S^3 is tame if and only if it has the concentral enclosure property and pierces a disk at each point. Microfilm $2.75; Xerox $4.00. 75 pages.

ON RANDOM SETS, DERIVED FROM A SUBSAMPLE, FOR STATISTICS BASED ON THE ENTIRE SAMPLE.

(L. C. Card No. Mic 61-1923)

James Charles Hickman, Ph.D.
State University of Iowa, 1961

Co-chairmen: Professor Allen T. Craig
Associate Professor Robert V. Hogg

Sets bounded by random variables that are based on the first k, $k < n$, members of a random sample of n from a specified distribution of probability are studied. These sets have the property that before the random sample is drawn, the probability is 1-a, $0 < a < 1$, that they contain a point whose coordinates are specified functions of all of the members of the random sample. Usually these specified functions will be estimates, based on all of the members of the random sample, of the distribution parameters. Then, when numerical values for the first k members of the random sample are obtained, the set is fixed and affords a regional forecast, along with an index of the reliance to be placed on this forecast, of the eventual parameter estimates based on all members of the random sample. Such sets and indices are called "forecast sets" and "forecast coefficients."

Random sets upon which forecast sets for the maximum likelihood estimates for m and σ^2, when the sample is from a normal distribution with parameters (m,σ^2) are obtained. In addition, a random set upon which a forecast set for the pair $(\bar{X},S^2)$ is also found.

Next the multiple regression model where the mean of a normal distribution is $\sum_1^m B_j c_j$, where the c's are observable parameters, is studied. In this section the results are obtained under certain assumptions necessary to insure the existance of maximum likelihood estimates for $\{B_j, (j=1,..,m), \sigma^2\}$ based on both the entire sample and certain subsamples. Granted these assumptions, random sets upon which forecast sets can be based are then found for the estimate of the variance, estimates of $B_j, (j=1,..,m)$, both individual and collectively, and for estimated values on the regression surface for given observable parameters.

For the usual analysis of variance one way layout, random sets upon which forecast sets can be based are found for the variance estimate, the estimated difference between two group means, and for the estimated group means considered both individually and collectively. In addition, random sets upon which simultaneous forecast intervals for estimates of all contrasts between group means [as defined by Scheffé, "Analysis of Variance," John Wiley and Sons, Inc., p. 66] are found.

Finally, the usual analysis of variance two way layout, with n, $n > 1$, observations per cell is considered. In this model the mean of each normally distributed random variable in cell (i, j) is $d + a_i + b_j + c_{ij}$, $i=1,..,r$, $j=1,..,c$. Random sets upon which forecast sets can be based are found for the estimate of the common variance, and for the components of the means of the various distributions. A method for finding simultaneously a set of random intervals upon which simultaneous forecast intervals for contrasts among the estimates of the a's is indicated and the obvious extension to the b's is noted.
Microfilm $2.75; Xerox $3.00. 35 pages.

EXPONENTIAL BOUNDS FOR THE PROBABILITY OF ERROR IN DISCRETE MEMORYLESS CHANNELS

(L. C. Card No. Mic 61-1113)

Samuel Kotz, Ph.D.
Cornell University, 1960

It is well known in the literature ([1], [2], [3]) that, for any discrete memoryless channel and arbitrary $\varepsilon > 0$

there exist positive constants c_1 and c_2 with the following property: For any n there exists a code of length $2^{n(C-\varepsilon)}$ and probability of error not greater than $c_1 e^{-nc_2}$, where n is the "length" of transmitted and received words and C is the capacity of the channel.

In this thesis we investigate the values of the constants c_1 and c_2 using the following two different methods:

I) The method of "generating π-sequences" introduced by Wolfowitz in [2], which permits one to calculate explicitely the length of a code for a d.m.c. and its probability of error, using simple probabilistic arguments.

II) The method of "mutual information" introduced by Shannon in [4], which was used by Blackwell, Breiman and Thomasian in [3] for the same purpose as ours.

The related problems for the finite simultaneous d.m.c. and for the finite simultaneous d.m.c. with channel probability function known to the sender only are investigated.

In Chapter 1 we define the basic concepts of the theory and state the problems to be investigated.

In Chapter 2 we use the method I) for the case of a binary symmetric channel.

In Chapter 3 we extend these results to more general cases.

In Chapter 4 we use method II) for special cases of binary symmetric and general symmetric channels.

In Chapter 5 we discuss the case of finite simultaneous symmetric channels.

In Chapter 6 the general result for discrete memoryless channel with input alphabet having a(>1) elements and output alphabet having b(>1) elements is obtained.

This final result reads as follows: For any $\frac{1}{2} \geq \varepsilon > 0$ there exists a code for a discrete memoryless channel with input and output alphabets consisting of $a > 1$ and $b > 1$ elements respectively with a length $N > 2^{n(C-\varepsilon)}$ and with the probability of error $\lambda = 2\exp_e\{\frac{-n\varepsilon^2}{g(c)(\log c)^{2-\delta}}\}$, where $c = \min(a,b)$, the coefficient $g(c)$ is less than 16 for all $c \geq 2$ and approaches 4 asymptotically as $c \to \infty$, and δ is a positive constant depending on ε and c, which approaches 0 as $c \to \infty$. This theorem holds for any n, with the obvious restriction that $2\exp_e\{\frac{-n\varepsilon^2}{g(c)(\log c)^{2-\delta}}\} \leq 1$.

Analogous results for finite simultaneous discrete memoryless channels of the two kinds mentioned above are obtained. The last theorems are an improvement of the similar results obtained in [3]. In the appendix the values of the input probabilities for capacities of discrete memoryless channels of input and output alphabet consisting of 2 letters each are tabulated.

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Microfilm $2.75; Xerox $5.00. 97 pages.

STRESS IN THE VICINITY OF A CRACK IN A THICK ELASTIC PLATE

(L. C. Card No. Mic 61-1445)

Morton Lowengrub, Ph.D.
Duke University, 1961

Supervisor: J. J. Gergen

In this paper we are concerned with the problem of determining the elastic stress distribution in a neighborhood of a penny-shaped crack in a plate of finite thickness, but infinite radius, which is deformed symmetrically with respect to its axis of revolution. We shall employ the method of Hankel Transforms which, when we apply the boundary conditions, leads to the problem of solving a pair of dual integral equations.

Since the deformation is symmetrical with respect to an axis of revolution, it is most convenient to employ cylindrical coordinates (r, θ, z), and to take the z-axis along the axis of symmetry. The stress components will be denoted by $\sigma_r, \sigma_\theta, \sigma_z, \tau_{\theta z}, \tau_{zr}, \tau_{r\theta}$, while the components of the displacement vectur $\underline{u}$ will be taken as (u, v, w), where $u = u_r$, $v = u_\theta$, and $w = u_z$. We shall also employ the following notation: E to represent Young's modulus; ν, Poisson's ratio; d, the thickness of the plate; and a, the radius of the crack.

We consider two sets of boundary conditions in formulating the mixed boundary value problem. In the first case, we assume that the surfaces of the plate are given a displacement ϵ, so that we must solve the equilibrium equations subject to the boundary conditions:

on $\underline{z = o}$:

$w = o, \quad r > a$

$\tau_{rz} = o, \quad r > o$

$\sigma_z = \frac{-(1-\nu)\epsilon}{(1+\nu)(1-2\nu)d} E, \quad o < r < a.$

on $\underline{z = d}$:

$w = o, \quad r > o$

$\tau_{rz} = o, \quad r > o.$

For the second case, we assume that the surfaces of the plate are pulled by a uniform tension F so that the boundary conditions are:

on $\underline{z = o}$:

$w = o, \quad r > a$

$\tau_{rz} = o, \quad r > o$

$\sigma_z = -F, \quad o < r < a$

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on $\underline{z = d}$:

$$\sigma_z = 0, \quad r > 0$$

$$\tau_{rz} = 0, \quad r > 0.$$

Using the boundary conditions, we find that the following pair of dual integral equations arise for the first problem:

$$\int_0^\infty K(s\delta)\psi(s)J_0(s\rho)ds = 1, \quad 0 < \rho < 1$$

$$\int_0^\infty \psi(s)J_0(s\rho)ds = 0, \quad \rho > 1$$

where

$$K(s\delta) = s\delta \frac{s\delta + \sinh s\delta \cosh s\delta}{\sinh^2 s\delta}$$

and

$$\delta = \frac{d}{a}, \quad \rho = \frac{r}{a}$$

For the second problem we derive a similar set of integral equations. Since the techniques for solving the two sets of equations are similar, we solve only the equations derived by applying the first set of boundary conditions.

The techniques we apply to find the solution to the above equations are those due to N. N. Lebedev and Ya. C. Uflyand. Using these methods, we are able to derive expressions for the stress and displacement components for the case δ very large.

On $z = 0$, we obtain the following expression for the z-component of the displacement vector $\underline{u}$:

$$w(\rho) = \left\{\frac{4(1-\nu)^2}{\pi(1-2\nu)}\left(\frac{\epsilon}{\delta}\right)\left[1 - \frac{.51001}{\delta^3} - \frac{.01099}{\delta^5}(23 + 10\rho^2)\right]\right.$$

$$\left.(1-\rho^2)^{\frac{1}{2}}\right\} + 0(\delta^{-7})$$

We show that in the case $\delta \to \infty$, this expression is in agreement with a result previously obtained by I. N. Sneddon using an entirely different procedure.

Microfilm $2.75; Xerox $3.00. 40 pages.

CAPACITY AND TCHEBYCHEFF POLYNOMIALS

(L. C. Card No. Mic 61-1771)

Rogers Joseph Newman, Ph.D.
University of Michigan, 1961

The purpose of this dissertation is two-fold: (1) to present, under one title, the major results concerning Tchebycheff polynomials in the complex plane as they relate to the capacity of plane sets, and (2) to contribute to this field of study by extending some of these results and establishing new ones. The results presented date from 1923.

In Chapter I, it is shown that, for sets in 3-space, the capacity of a set as defined by Wiener, can be approximated as closely as desired by the capacities of "condensers" defined electrostatically. The other original contributions of this dissertation are presented in Chapter III and are described below.

Chapter II gives a complete presentation of the major known results from 1923. These results are due chiefly to Fekete and Szegö. Presented here are the following: (1) Fekete's proof that, for closed and bounded sets E in the plane,

$$\lim_{n\to\infty} \max_{z\in E} |t_n(z)|^{\frac{1}{n}} = \tau(E),$$

where $t_n(z)$ is the Tchebycheff polynomial of degree n for E and $\tau(E)$ is the transfinite diameter of E; (2) Fekete's proof that, for closed and bounded sets E whose complements are simply connected $\tau(E) = \gamma$, where γ is Robin's constant; (3) Szegö's extension of this result to sets E whose complements are not simply-connected, and finally, (4) a result of Ullman on the zero location problem.

In Chapter III, some of the results of Chapters I and II are extended. With the definition of electrostatic capacity of sets in 3-space as a guide, the notion of capacity for plane sets is developed from potential theory. This development leads to γ as the definition of capacity in the plane. This definition, along with (1) shows that capacity is equivalent to transfinite diameter.

It is known[1] that for any closed and bounded infinite E; the number of zeros of the Tchebycheff polynomials which can lie outside of a given level curve of Green's function (assumed to exist for E) is bounded. An estimate for this bound is obtained.

On general norms, some remarks are made concerning conditions for monotonicity and continuity of quasi-Tchebycheff norms and, finally, a condition for any norm to be a quasi-Tchebycheff norm is established.

1. Ullman [12].

Microfilm $2.75; Xerox $4.00. 72 pages.

SOME CONTRIBUTIONS TO THE THEORY OF CASCADES

(L. C. Card No. Mic 61-1414)

Peter E. Ney, Ph.D.
Columbia University, 1961

An object possessing prescribed characteristics exists at a given time. In a probabilistically specified manner this object gives rise to other objects with various characteristics. These further reproduce, and so on. Of particular interest is the case when the objects are particles, and the characteristics are the energies of the particles. In this case the above phenomenon is called a cascade process.

The evolution of such a process is described by a function which gives the distribution of the number of particles at any specified energy level at any particular time, and which can be shown to satisfy a fundamental integral equation. This thesis starts with a discussion of the fundamental equation, and a derivation of results on the energy distribution and its moments.

The total energy of the cascade is the subject of the second phase of the study. The distribution function of this random variable is again shown to satisfy an integral equation. It is then proved that, under certain conditions,

a suitably normalized form of the total energy at time t is a semi-martingale, and that this family of random variables converges to a limit random variable with probability one as $t \to \infty$. Some properties of this limit variable are investigated.

The third and final part of the thesis introduces the idea of a finite cascade. This cascade is characterized by the fact that particles below a certain energy level cannot further sub-divide. The process thus reaches a stable terminal state consisting of a finite number of particles. The energy distribution is investigated in this terminal state. Microfilm $2.75; Xerox $6.60. 136 pages.

AN ANALYSIS OF LOWER DIVISION MATHEMATICS COURSE OFFERINGS IN SELECTED UNIVERSITIES BETWEEN 1872 AND 1952

(L. C. Card No. Mic 61-1376)

Robert Samuel Sloan, Ph.D.
The University of Texas, 1961

Supervisor: Dr. James W. Reynolds

The purpose of this study was to determine trends in lower division mathematics course offerings in thirteen selected universities in the United States in the period from 1872 to 1952 with special reference to courses that have been added or dropped and to course content.

University catalogues were studied to determine course offerings. Catalogue course descriptions and tables of contents of selected textbooks of different periods were used to investigate course content. Related literature was studied in an attempt to determine motivating forces behind changes in the course offerings.

It was found that there was a gradual change toward offering the traditional college mathematics courses at lower levels in the curriculum. For example, approximately one-half of the universities studied offered calculus in the lower division in 1872. In 1952 all the universities studied offered calculus in the lower division and in approximately one-half of them, courses which included some calculus were open to freshman students.

Among the important changes found were the addition of many new courses such as mathematics of finance, statistics, and cultural courses and the great increase in the total number of courses offered, especially courses in which two or more different subjects were combined in a single course. In addition, there was a great increase in the number of special courses for special groups of students. Some other notable changes were that plane geometry, surveying, descriptive geometry, and mechanics were removed from the course offerings of the lower divisions of the departments of mathematics in the selected universities.

Perhaps the greatest changes in course content were noted in calculus and in algebra. Since calculus was introduced in many cases in the freshman year, more advanced topics could be included in the sophomore year. In the latter part of the period considerable attention was given to advanced algebra, but, in contrast, several of the universities offered courses in intermediate algebra for students who were unprepared for college algebra.

Strong evidence was found that changes in the mathematics course offerings were the result of changes in our society--especially changes in the field of technology and business and in concepts of the educational process.

Microfilm $5.30; Xerox $18.70. 414 pages.

EXTENDED ALGEBRA OF POLYNOMIALS IN SEVERAL VARIABLES FOR A DIGITAL COMPUTER

(L. C. Card No. Mic 61-1450)

Leland Hendry Williams, Ph.D.
Duke University, 1961

Supervisor: Francis J. Murray

In this thesis an interpretive system for automatic polynomial manipulation by a digital computer is presented. Its purpose is to make possible the error free solution of certain types of problems which require formal manipulation of polynomials. The polynomial manipulation system (PMS), therefore, capitalizes on the logical capability rather than the arithmetic capability of a digital computer. The PMS is an exercise in machine symbol manipulation.

It should be explained that there are two categories of work currently being done in the field of machine symbol manipulation. One can be characterized as general, the other as specific. To the former category belongs the work of Newell, Simon, Shaw, McCarthy, Perlis and others on general symbol manipulation languages or procedures. To the latter category belongs such work as compilers (e.g., FORTRAN for the IBM 704) and the recent work on machine translation of languages.

It is quite possible to examine a specific problem such as polynomial manipulation within the framework of some general procedure. There is a school of thought with essentially the premise that any symbol manipulation problem should be so examined. However, the basic principle of this thesis is that a general approach is not the best way to deal with a specific problem as complex as polynomial manipulation. It is natural to expect that some efficiency would be lost to the generality. Efficiency is definitely required for a polynomial manipulation system to be practical.

The PMS is capable of handling polynomials in m variables where m is determined by the number, α, of digits required to represent the degree in each variable and by the word length of the machine. The product, $m\alpha$, cannot be greater than the word length. The formal manipulations of the PMS are those producing the sum, difference, product, remainder after division with respect to one variable, and eliminant of two polynomials. The eliminant is produced by Euclid's Algorithm. There are many uses in applied mathematics for just these manipulations. More important, though, are the more complex manipulations which are combinations of these. For instance, the substitution of a rational function for a variable in a polynomial is accomplished by the subtraction

and remainder processes. Also the practical solution of large systems of polynomial equations is made possible by the eliminant process.

The basic problem in developing the PMS was the choice of a polynomial representation. The requirements controlling the choice were that the representation must have a machine realization which is consistent with computer logic. The logical ability of most modern computers is such that the desired procedures could probably be carried out for any reasonable representation. However much efficiency is to be gained by a judicious choice. A sum of monomials representation was the one chosen. The basic machine realization consists of a table whose arguments are subscripts (or ordered exponents) and whose values are the numerical coefficients.

The machine methods for the formal manipulations are presented by flow charts. These are logical descriptions of the elementary processes and logical decisions involved in the various formal manipulations. The methods can be programmed for any digital computer of sufficient size. They have been programmed for the IBM 650. Some examples of this program's use are given in the appendix.

It is necessary to consider the possible propagation of errors in the numerical coefficients. Such errors may result from the machine's restricted word length. A qualitative error analysis is presented as the best one consistent with rather stringent space requirements.

Several areas of expansion for the PMS are indicated. Some of them require only additional programming effort. Others require some theoretical effort also. These areas include a polynomial equation solution routine, a literal coefficient capability, and an application to the formal solution of certain systems of ordinary differential equations. Microfilm $2.75; Xerox $4.20. 78 pages.

BAND-LIMITED FUNCTIONS AND IMPROPER PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS

(L. C. Card No. Mic 61-1712)

Jack Miles Zimmerman, Ph.D.
University of Southern California, 1961

Chairman: Professor Kyner

The solutions to a great many important boundary or initial value problems in partial differential equations do not depend continuously on the given data or a finite number of its derivatives. Such problems have been called improper by Hadamard. Examples of improper problems are the heat equation for preceding times (the "backwards" heat equation) and the Cauchy problem for Laplace's equation. In order to obtain useful solutions to such problems, it is necessary to place a priori restrictions either on the class of allowable solution or on the class of initial or boundary data.

In the present work we restrict the class of given data to band-limited functions, i.e., functions which possess Fourier transforms with compact support. We say that f(x) belongs to the class $B(\omega_0,x)$ if f can be written in the form $f = f_1 + f_2$, where f_1 has an L_2 Fourier transform which vanishes outside the interval $[-\omega_0, \omega_0]$ and f_2 has a Fourier transform defined by a finite sum of delta functions and their derivatives with supports contained in $[-\omega_0, \omega_0]$. Convergence for f_1 and f_2 functions is introduced in terms of the L_2 norm and the uniform norm on finite intervals, respectively.

In Chapter 1 several known or easily proved results concerning f_1 and f_2 functions and their transforms are reviewed. In particular, we prove a generalized form of the Sampling Theorem for the functions f_1 which includes estimates of the errors incurred when the classical sampling representation is replaced by one involving the approximate values of f_1 at only a finite number of points.

In Chapter 2 we treat the backwards heat equation by restricting the given data f to the space B. In this manner we obtain a solution $u = u_1 + u_2 \in B$ which depends continuously on $f = f_1 + f_2$. A numerical scheme for the explicit determination of such solutions when the data are only approximately known is then developed and estimates of the errors in these methods are derived.

The Cauchy problem for Laplace's equation is treated in Chapter 3 by similar methods.

In Chapter 4 the general Cauchy problem for the equation $L[u(x, y)] = f(u(x, y))$ is studied, where

$$L = \sum_{p+q \leq m} a_{pq}(y) \frac{\partial^{p+q}}{\partial x^p \partial y^q} .$$

In some cases (e.g., if L is elliptic) such problems are improper. We restrict the Cauchy data to f_1 functions, and in addition the right member of the above equation is replaced by a filtered version $\overline{f(u)}$. Under suitable restriction on f(u) and the coefficients $a_{pq}(y)$, the existence of a unique band-limited solution is proven (for $-\infty < x < \infty$ and sufficiently small y) by reducing the Cauchy problem to an equivalent pair of integral equations and then employing the method of successive approximations. It is shown that the solution depends continuously on the boundary data and the function $\overline{f(u)}$.

These methods are generalized to treat the Cauchy problems for the equations

$$L[u] = \overline{f(u, \frac{\partial u}{\partial x})} \quad \text{and} \quad L[u] = \overline{f(u, \frac{\partial u}{\partial y})} .$$

Microfilm $2.75; Xerox $7.40. 159 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

GEOLOGY AND PETROLOGY OF THE COTOPAXI-HOWARD AREA, FREMONT COUNTY, COLORADO.

(L. C. Card No. Mic 61-1824)

Charles Anthony Salotti, Ph.D.
University of Michigan, 1961

The Cotopaxi-Howard area forms an irregular plateau west of the Front Range along the Arkansas River in south-central Colorado. Precambrian metamorphic and igneous rocks underlie most of the area. North of Cotopaxi, a large outlier of Ordovician dolomite and quartzite, and Lower Pennsylvanian sediments cap a large eastward dipping fault block. A thick sequence of largely non-marine clastic Pennsylvanian-Permian sediments lie in fault contact with Precambrian rocks near the western boundary. Rare Laramide (?) lamprophyric dikes cut Precambrian rocks; and rhyolite to andesite pyroclastic and flow rocks--a southern extension of the Thirtynine Mile andesite series of South Park--cover the northeastern corner and form isolated remnants along the western and southern boundaries. Quaternary travertine is present as isolated patches along Bernard Creek and the Arkansas River. Unconsolidated alluvium lies along the Arkansas River basin and its main tributaries.

The Precambrian metamorphic rocks include two distinctly separate units, both pre-Pikes Peak granite; the widely distributed regionally metamorphosed Idaho Springs formation, and a younger local unit, the Mitchell Gulch group, which is lower in grade and shows more contact than regional metamorphic effects. Rocks assigned to the Idaho Springs formation include biotite schist and gneiss, hornblende gneiss, amphibolite, nodular sillimanite schist, minor lime-silicate rock, and ferruginous quartzite. Idaho Springs rocks, now intimately penetrated by quartzo-feldspathic material, were already intermediate to high grade metamorphic rocks prior to the introduction of Pikes Peak granite. The chief effects of the granitic emplacement was the metasomatic development of sillimanite in biotite rocks in the areas of greatest granitic contamination; and subsequent large scale retrograde metamorphic effects, which principally resulted from the expulsion from the cooling granite of large quantities of water. Retrograde metamorphic effects include sericitization, saussuritization, uralitization, and chloritization.

The Mitchell Gulch group crops out over approximately four square miles just northeast of Howard. Rock types include quartz-albite-mica schist, quartz-albite-anthophyllite schist, quartz-albite-garnet schist, and minor phyllite. Although intruded by Pikes Peak granite, Mitchell Gulch rocks exhibit little lit-par-lit migmatization. They form a poorly defined anticline which plunges southeast at a moderate angle. The unusually high sodium content of these rocks is attributed to sodium metasomatism, presumably associated with the emplacement of Pikes Peak granite. The sharp contrasts between Idaho Springs and Mitchell Gulch rocks indicates that there were two separate orogenic cycles, both pre-Pikes Peak granite.

The Precambrian structure suggests that the Cotopaxi-Howard area formed the southwestern flank of the large front Range anticlinorium into which Pikes Peak granite was intruded. The Mitchell Gulch group formed as a separate unit on the southwestern flank of the anticlinorium. The large north-south trending Pleasant Valley and Bernard Creek faults are high-angle block faults. Both faults originated in response to the relaxation of the east-west compression that formed the Sawatch Range in Laramide time. The Pleasant Valley syncline, shown on earlier large scale maps, does not exist.

The economic deposits of the area are diverse and geologically interesting, but are largely non-commercial. A few small pegmatites have been mined for feldspar and rare-earth minerals. A few small rare-earth bearing pegmatites quite likely remain undiscovered, but no large deposits are likely. "Red bed" copper mineralization is widely dispersed in Pennsylvanian-Permian rocks, but only in minor amounts. The old copper-zinc deposit at Cotopaxi was reinvestigated and shown to be pyrometasomatic rather than magmatic in origin.

Microfilm $3.80; Xerox $13.30. 294 pages.

MORPHOLOGY, MINERALOGY AND CHEMISTRY OF THE LEBANON SILT LOAM.

(L. C. Card No. Mic 60-6821)

Clarence Leland Scrivner, Ph.D.
University of Missouri, 1960

Supervisor: C. E. Marshall

The Lebanon silt loam of the Missouri Ozarks region is shown to have a strongly expressed fragipan situated both above and in a zone of chert accumulation.

The chert accumulation marks a lithologic discontinuity which is also reflected in particle size distribution, mineralogy of the silts and clays and chemical features of soil and clay fractions. Loess is suggested as the nearly chert free mantle of 12 to 30 inches thickness. Residuum from dolomite appears to account for the underlying materials with the chert accumulation representing an erosional accumulation on a former land surface. Mineralogical evidence indicates at least a two foot zone of measurable mixing of the parent materials.

Randomly interstratified montmorillonite, illite and vermiculite dominate the clay mineralogy of the loess derived horizons whereas kaolinite and illite dominate in the underlying paleosol and residuum from dolomite. The variation in clay mineralogy is demonstrated by X-ray analysis. Electrochemical measurements demonstrate a

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

close relationship between clay mineralogy and chemical behavior of soil clays.

Exchangeable bases in this acid and leached soil are shown to be correlated with clay mineralogy. A large content of vermiculitic minerals is associated with a low Ca/Mg ratio.

Weathering zones within 8 inches distance from the dolomite are characterized by almost complete removal of carbonates, by increasing kaolinite, by decreasing feldspars and by hydration of the illite which was formerly present in the dolomite.

Microfilm $2.75; Xerox $8.00. 175 pages.

SOME RELATIONSHIPS IN THE SYSTEM ZIRCONIA-FERROUS OXIDE-SILICA

(L. C. Card No. Mic 61-1805)

Ralph Gordon Wells, Ph.D.
University of Michigan, 1961

It has been established that there are two compatibility regions above 1550°C in the system ZrO_2-FeO-SiO_2. Below 1550°C there are three compatibility regions. Above 1550°C, the regions are bounded by the tie lines ZrO_2-Fe_2SiO_4-SiO_2, and ZrO_2-FeO-Fe_2SiO_4. Below 1550°C the regions are: ZrO_2-Fe_2SiO_4-FeO, ZrO_2-Fe_2SiO_4-$ZrSiO_4$, and $ZrSiO_4$-Fe_2SiO_4-SiO_2. It was found that zircon has a small region of primary crystallization which does not include the stoichiometric composition of the phase.

Ferrous oxide and zircon are not compatible. This results in some degree of dissociation of zircon when in contact with ferrous oxide slags at temperatures of 1200°C or even lower. This can be very important in the consideration of zircon refractories.

The binary systems ZrO_2-Fe_2SiO_4, $ZrSiO_4$-Fe_2SiO_4, and ZrO_2-FeO were determined for temperatures below 1500°C. Invariant points in the ternary system ZrO_2-FeO-SiO_2 were also determined. On the basis of these data a phase diagram of the liquidus surface below 1500°C is presented.

The effects of impurities on the monoclinic-tetragonal phase transformations of zirconia is considered and the results of the author are compared to those found in the literature. A mechanism is proposed to explain the observed effects.

Some considerations are made of the expected effects of ferrous oxide slags upon zircon and zirconia refractories based on data from this investigation.

Microfilm $2.75; Zerox $3.60. 62 pages.

A HISTORY OF THE LAWRENCE CONSERVATORY OF MUSIC

(L. C. Card No. Mic 61-1727)

Stephen Ellis Busch, Ed.D.
University of Michigan, 1961

The Lawrence Conservatory of Music evolved from a department of music within the Lawrence College of Wisconsin located in Appleton. Instruction in the College began in 1849 under the auspices of the Methodist Episcopal Church. Music was offered to accommodate the women students.

The Conservatory was formed in 1894 and at first operated as one of a number of self-supporting departments which existed at the discretion and under the jurisdiction of the College trustees. These departments were not accepted as integral units of the College, and their faculties had no voice in the meetings of the College faculty.

Two factors have from time to time dominated the development of the Conservatory. These are the economic basis of its operation and the quality of leadership available to it in the office of its director or dean and in the presidency of Lawrence College. For almost forty years, 1894-1933, the College officials expected the Conservatory to be self-supporting through its fees and to pay for its own physical plant. Between 1914 and 1929 the Conservatory produced profits which totalled about $100,000. Not until 1933 was the Conservatory permitted to operate solely for its educational merit and for the general benefits it brought to the College, irrespective of continuous operating deficits.

Prior to 1949 the Conservatory deans or directors usually managed the Conservatory business. Under William Harper, 1909-1912, the school was operated almost as a private business. After 1912 the College trustees hired the director on a commission basis with a guaranteed minimum income. The faculty was hired on the same basis until 1934 when they received a stated salary.

The College president intervened in Conservatory business at times of financial or managerial crises. Poor management of the Conservatory required President Plantz to procure three directors in two years, 1906-1908. Amidst a financial crisis in the great depression, President Wriston conducted music faculty meetings himself as part of a successful effort to make the Conservatory academically respectable. Wriston convinced the trustees that they should not discontinue the Conservatory even though it could no longer operate profitably.

Instruction in piano, voice, and melodeon was available at Lawrence from 1849 until 1887. In 1887, seven years before the Conservatory was founded, a Bachelor of Music degree was instituted with applied study as the core of the music requirement. Almost sixty hours of academic courses were requisite in the five-year curriculum. Those who completed only the musical work received diplomas. A two-year curriculum for a teacher's certificate was added in 1908.

By 1912 the music enrollments totalled one hundred and seventy-seven. During the 1920's annual music enrollments averaged about four hundred and fifty. Yet, the majority of these figures represent special and preparatory students. The diploma and certificate curriculums were

the most popular; few students completed the degree curriculum. After 1929 the number of degree candidates greatly increased due to state teacher training requirements and an academic emphasis in the Conservatory. By 1934 the diploma and teacher's certificate were abandoned.

The Conservatory presently is an integral part of the College. The College enrollments average eight hundred a year. About one hundred students enroll annually in the Conservatory as candidates for the Bachelor of Music degree. Preparatory and special students also are admitted. The music curriculum is controlled by the Conservatory director and faculty, while academic requirements for the Bachelor of Music degree must be approved by the College faculty. Microfilm $2.75; Xerox $9.70. 211 pages.

THE ORCHESTRAL WORKS OF GÖSTA NYSTROEM: A CRITICAL STUDY.

(L. C. Card No. Mic 61-2095)

Peter Louis Kai Christensen, Ph.D.
University of Washington, 1961

Chairman: Kathleen Munro

The study deals with the orchestral works of Gösta Nystroem, who, as a representative of French modernism, is a key figure among Scandinavian modernists. The purpose of the dissertation is to describe the individual compositions through critical analysis; to show the composer's stylistic development; and to relate his techniques and aesthetics to the main stream of music history.

Gösta Nystroem's compositions include almost every medium of musical composition.[1] While he has been successful in every medium, two areas stand out, which at the same time are the basis of his reputation as a composer: the songs and the orchestral works.

The songs have long since won for Gösta Nystroem the love of his countrymen, and the orchestral works have brought him international acclaim and include several masterpieces. From an analytical viewpoint the interest centers around the concertos and symphonies, where he has concentrated his polyphonic techniques and form problems. But it must, however, be understood that Nystroem, the song composer, is ever-present also in the compositions of absolute music. In certain works, the song composer and the symphonist collaborate openly with perhaps the most original results: Sånger vid Havet (Songs by the Sea) for soprano and orchestra; Sinfonia del Mare, a symphony in one movement which includes a song; and the opera Herr Arnes Penningar after a novel by Selma Lagerlöf. In order to show the stylistic development of the composer the orchestral works have been discussed in chronological order.

The author travelled to Scandinavia in the summer of 1959 for the purpose of gathering material. Most of the scores are available from Svenska Tonsättares Internationale Musikbyra (STIM) and Nordiska Musikförlaget in Stockholm, and both of these institutions permitted the present writer to borrow them for an extended period of time. The Swedish State Radio kindly let the author listen to their tapes of Nystroem's music. The dissertation contains a considerable amount of translations by the present writer of articles, reviews and direct quotations from many of Scandinavia's leading composers and critics. This period of study was climaxed by a visit to the home of Gösta Nystroem on the island of Särö on the west coast of Sweden a few miles south of Gothenburg. The composer's cooperation has been invaluable and he consented to have our conversations recorded.

The conclusions attempt to summarize the uniqueness of Nystroem's techniques, and to describe his relationship, generally, to the artistic currents of the 1920's in France, and specifically, to the idiom of Honegger's oratorio King David. The author indicates that Nystroem has drawn symphonic conclusions from this idiom, while Honegger, in his own symphonies, used another musical language.

1. A full catalogue of compositions by Gösta Nystroem is found in the Appendix.

Microfilm $3.65; Xerox $12.85. 281 pages.

THE WORKS OF JOHANNES VINCENET. [with] MUSICAL SUPPLEMENT.

(L. C. Card No. Mic 60-6981)

Bertran Earl Davis, Ph.D.
The University of North Carolina, 1960

Supervisor: Glen Haydon

The dissertation is a style critical study of the musical works of the composer Vincenet with additional chapters on biographic data and the manuscripts. The musical supplement presents the known works of Vincenet in modern score form. Four settings of the Ordinary of the Mass and four secular songs may be definitely attributed to the composer.

We assume from available biographic data that Johannes Vincenet was a contemporary of Dufay. Both Vincenet and Dufay were singers in the Papal choir in 1428 and there is documentary evidence that Vincenet was later connected with the Spanish court in Naples where he probably died about 1479.

The manuscripts containing the works of Vincenet belong to the second half of the fifteenth century. A few of the extant works may have been composed as early as 1440.

The study of the musical style is treated systematically under the headings: Modality, Rhythm, Melody, Texture, Cadences, Description of Forms, Dissonance Treatment, and Placement of Text.

The influence of the sixth-chord style deriving from the early fauxbourdon practice is of decisive importance with respect to all elements of the style. A type of vertically (or chordally) oriented counterpoint is sometimes evident in the reuse of material in successive sections of one composition. While the texture is usually polyphonic, imitative treatment is normally limited to the discant-tenor voices.

An evolution leading from use of the cantus firmus technique to use of the transcription technique may be traced in the Mass production. An intermediate stage in the evolution is shown in one Mass where the discant of the model is freely transcribed while the tenor of the

model is employed as a cantus firmus. The Mass a 4 O gloriosa regina mundi employs a fully developed transcription technique and draws consistently upon all three voices of the model in each section of the Mass while cantus firmus treatment is abandoned. Since the manuscripts preserving the Mass O gloriosa regina mundi may be dated at about 1480, this work must be regarded as one of the earliest known transcription Masses.

Thirty-five pages of the dissertation are devoted to a systematic study of dissonance treatment. Dissonance occurs frequently but is carefully treated on the whole in accordance with the new interest in euphony which developed during the fifteenth century.

The dissertation consists of the text, pp. xiii, 164 and a musical supplement, pp. ii, 386.

Microfilm $7.20; Xerox $25.65. 566 pages.

THE SACRED MUSIC OF GIAMMATEO ASOLA [with] MUSICAL SUPPLEMENT.

(L. C. Card No. Mic 60-6985)

Donald Mahlon Fouse, Ph.D.
The University of North Carolina, 1960

Supervisor: Glen Haydon

Asola was a prolific composer of sacred music. His output consists of approximately forty Masses, well over fifty motets, sixty-one Latin hymns, along with numerous Vesper psalms, Cantelenas, falsibordoni, Introits, Alleluias, Lamentations, Laudes, Passions, and other music for the Offices.

Asola's Masses are similar to Palestrina's Masses in that they represent stylistically the last stage in the systematizing of dissonance and the use of certain time-values in particular rhythmic contexts. Most of the procedures of the late sixteenth century, from the use of block chordal style to imitative settings with canon, are represented in the Masses of Asola. However, most of the writing is in a free, imitative contrapuntal style, counterbalanced occasionally with brief sections of free, non-imitative contrapuntal writing.

The Masses are of full length, usually showing a Palestrina influence in style but not without some of the milder innovations of the Venetian school – particularly in the eight-voice Masses in cori spezzati style. All the Masses but two are not based on any pre-existent models and hence are identified as "free" Masses. Asola's Requiems follow the general procedures of the polyphonic Requiem of the Renaissance, except he set polyphonically the Dies irae.

Asola's motet is generally quite brief and consists mostly of an imitative contrapuntal style. The musical treatment of the motet is characteristic of the form in that each line or division of the text has its independent theme, generally imitated in all voices, before the entrance of the next line of text. The motets are most frequently based on Antiphons which they paraphrase quite freely.

As in Palestrina style the starting point of the Asola style is the melodic line. The nature of the music is essentially polyphonic, the polyphony of simultaneously sounding melodic lines. Chromaticisms and dissonant skips, along with unduly sharp accents and extreme contrasts, are avoided. Most of the melodic lines are flowing and balanced in respect to interval succession, general pitch contour, and rhythmic contour.

In all essential respects Asola's modal writing differs in no way from Palestrina's writing. Dorian and Dorian transposed are the most frequently found. Phrygian and Lydian with a B flat are also common, particularly in the Masses. Outside of the Masses the use of Mixolydian is very frequent. Ionian and Aeolian are infrequent in appearance.

No basso continuo parts to Masses or motets were found. The first to appear seems to have been an added organ part in a 1624 edition of what were three-voice Masses written by Asola in 1588. This organ part is nothing but an untransposed unfigured bass line to a pair of transposed Masses.

The head motif almost always appears along with some recurring motives, giving the Mass formal coherence whether there is a cantus firmus or not. Frequently the motif recurs in the body of the Mass, further contributing to the formal coherence. Musical rhyme is not usually found in the Masses. However, certain cadential formulae which tend to strengthen the formal coherence are frequent in appearance.

Asola represents, in his treatment of dissonance as well as in other areas, the highest traditions in late Renaissance composition as exemplified particularly by the late compositions of Palestrina. Only the passing note, the lower "dissonant returning-note," the suspension, and the cambiata are of frequent occurrence. Even the anticipation involving a descending second and upper "dissonant returning-note," frequent in the style of Palestrina, is rare in the style of Asola.

Microfilm $3.50; Xerox $12.15. 269 pages.

STRAVINSKY'S INSTRUMENTATION: A STUDY OF HIS ORCHESTRAL TECHNIQUES [with Musical Composition] STRING QUARTET NO. 1.

(L. C. Card No. Mic 61-122)

Lawrence Thomas Fredrickson, D.M.A.
University of Illinois, 1960

The purpose of this study is to examine Stravinsky's mastery of instrumentation as exemplified by his works for, or including, the orchestra, from Feu d'artifice (1908) to Threni (1958). The text of the thesis is composed of an introduction and five chapters.

Chapter I is concerned with the orchestra at the beginning of the twentieth century; the prevailing orchestral techniques; the predominating influences of Wagner, Tschaikovsky, Strauss, Debussy and, to a lesser extent, Rimsky-Korsakov and Glazounov; and the two concepts of orchestration that have developed in the history of the orchestra: the concept of the blending of colors toward a homogeneous whole (Brahms, Wagner, Strauss, Franck, D'Indy, Hindemith) and the concept of "separateness" – three main distinct and self-contained instrumental groups, whose functions and colors should be clearly separated and in sharp contrast to one another (Glinka, Berlioz, Tschaikovsky, Rimsky-Korsakov, Stravinsky).

In this study, Stravinsky's career is divided into early (1908-1917), middle (1917-1952) and late (1953-1960) periods, which are discussed in detail in Chapter II, Chapter III and Chapter IV. In Chapter II, the early period is subdivided into three groups: the first consisting of Feu d'artifice and L'oiseau de feu; the second including Petrouchka and Le sacre du printemps; the third, Le chant du Rossignol. In the first group, Stravinsky shows his mastery of the orchestral conceptions of his forerunners; in the second group are begun those experiments in timbre that were to culminate in L'histoire du soldat, in which the Romantic ideal was negated by the substitution of tone contrast for expression; and in the third, Stravinsky begins, with Le chant du Rossignol, his experiments in which the orchestra is treated as a chamber group, with a concertante concept of not only solo instruments, but instrumental groups as well. In Le chant du Rossignol are to be found the last remaining links to Stravinsky's early style which he subsequently abandoned for the conceptions generally known as Neo-classicism.

In this thesis, Stravinsky's career has been divided into early and middle periods at the year 1917. This seems most logical in a study of his orchestral techniques, because of the sharp reduction of orchestral forces that occurs in the years 1917-1918 with the composition of Renard and L'histoire du soldat. Chapter III describes: the extended middle period, which began with the abandonment of the large orchestra as used in the post-Romantic era, and with it the reduction of sonorities and a rejection of color and brilliance per se; Stravinsky's interest in the juxtaposition of unmixed and unsoftened blocks of sound; and his preoccupation with the combinations of instruments in which their individuality is clearly projected. Chapter III is concluded with an investigation of Stravinsky's revisions of his published works.

The division into middle and late periods is made at the year 1953, with the composition of the Septet, because the Septet marks Stravinsky's first tentative uses of the serial technique of composition. Works that employ the orchestra and that are subsequently examined in detail are: Canticum Sacrum; J. S. Bach: Choral-Variationen; Agon; and Threni. The influences of Schoenberg, Berg and Webern on Stravinsky's orchestration are examined, as is Stravinsky's use of the serialist technique known as Klangfarbenmelodie.

The conclusion (Chapter V) summarizes the orchestral techniques of the three periods and also defines those characteristics of Stravinsky's orchestral style which are to be found throughout his entire career: staccato doubling, mingled doubling, parallel and oblique motion, color dissonance, ictus scoring, percussive sweeps, perverted and inverted orchestration, and block construction. His innovations, preferred instruments, dislikes and mannerisms are also described.

Microfilm $2.85; Xerox $9.90. 220 pages.

THE TIENTOS, FUGAS, AND DIFERENCIAS IN ANTONIO DE CABEZÓN'S OBRAS DE MÚSICA PARA TECLA, HARPA Y VIHUELA.

(L. C. Card No. Mic 61-1284)

John Hughes, Ph.D.
The Florida State University, 1961

Outstanding among the composers of keyboard music of the sixteenth century was Antonio de Cabezón. As a result of his ability, his prominence as court organist for Charles V and Philip II of Spain, and the travels of the Spanish court, he exerted influence on the musicians of Europe and the British Isles. The variation technique, used so extensively by the English virginalists, was first brought to prominence by Cabezón. In the realm of performance none excelled Antonio de Cabezón as an organist. In the history of the organ the influence of the instruments of his day is still felt, particularly with regard to the family of reeds.

It is the purpose of the present study to determine Cabezón's compositional style in the tientos, fugas, and diferencias of his Obras de música.... As the basic source material four copies of the original print have been consulted through microfilms: one each from the National Library in Paris, the Royal Library in Brussels, the National Library in Berlin, and the National Library in Madrid. Transcriptions were made from the sixteenth century Spanish keyboard tablature into modern notation.

It was not the intention of this study to provide a new edition of the Obras de música.... Macario Santiago Kastner has presented two volumes of compositions by Cabezón, Antonio de Cabezón. Claviermusik, and Antonio de Cabezón. Tientos und Fugen. In these editions Cabezón's tientos and fugas are completely represented. Four of the diferencias are to be found in the first of the volumes named above. One of the unedited diferencias, Diferẽcias sobre, quiẽ te me enojo &c Isobel, is very attractive and is included in an appendix to this study. Also included in the appendix is a tiento and a fuga which were considered particularly representative of Cabezón's work in these fields. Cantus firmus compositions other than those specifically termed tientos, fugas, or diferencias were not considered because of a recent exhaustive study on the cantus firmus compositions of Cabezón by Elinore Louise Barber.

The first chapter presents a biographical sketch with observations of Cabezón's place in the period. The second chapter describes the source material. The original print is presented section by section, translations and examples given, including a complete index of the entire work. The third chapter is a study of sixteenth century Spanish organs insofar as their construction, specifications, and sound relate to the tientos, fugas, and diferencias of Cabezón. These three chapters form the first part of the study. The remaining two chapters constitute a detailed analysis of the tientos, fugas, and diferencias found in the Obras de música.... The analysis aims at a description of Cabezón's subjects, and three chief techniques employed in their treatment: counterpoint, improvisation, and variation. The music conveys no hint of restlessness, but rather proceeds steadily within established conventions, every device faithfully calculated. The tientos and fugas, so similar in style that they may be considered a single type, are

contrapuntally conceived, sections in imitative counterpoint contrasted with sections in free improvisation. The diferencias are variations of melodies generally known in the sixteenth century. Variation techniques primarily center around melodic ornamentation, although harmonic and rhythmic alterations do occur.

All of these works, the tientos and fugas, as well as the diferencias, are characterized by conservatism and sobriety; all of Cabezón's procedures are precisely calculated. These features show a composer interested not in innovation, but in faithful and artistic employment of established conventions of his time.

Microfilm $2.75; Xerox $8.60. 189 pages.

SANTA CLAUS: A MIME-OPERA BASED ON THE MORALITY BY E. E. CUMMINGS.

(L. C. Card No. Mic 61-1927)

Edwin Wolf London, Ph.D.
State University of Iowa, 1961

Chairman: Professor Philip Bezanson

Santa Claus, a mime-opera, is based very closely on a Morality of the same name written by E. E. Cummings, the distinguished American poet.

The nature of the text is such that explication of it is quite unnecessary. Whether it is equally as clear in its musical setting, only those who hear it can answer.

Divided into five scenes, this mime-opera lasts for approximately fifty minutes. There are five solo singing roles, a chorus of sixteen, an orchestra of fifteen, besides which a small group of dancers mime the action at the same time it is sung.

Santa Claus was produced for the first time in Iowa City, Iowa in April 1960 (with Mr. Cummings' permission) at which time it was given three performances.

Microfilm $3.05; Xerox $10.80. 236 pages.

CERTAIN INTEGRANTS OF MUSIC EDUCATION RELATED TO PARTICIPATION IN THE SECONDARY SCHOOL MUSIC PROGRAM

(L. C. Card No. Mic 61-1472)

Aaron Schmidt, Ed.D.
The University of Nebraska Teachers College, 1961

Adviser: Walter K. Beggs, Ph.D.

The Purpose and Procedure of the Study

The purpose of this study was to identify and evaluate certain integrants of music education which are related to participation by students in the secondary music education program offered by the public schools.

This involved: (a) selection of survey situation, (b) development of survey instruments, (c) distribution and return of survey instruments, (d) identification of integrants of music education, (e) conclusions, and (f) implications of the study.

The Nashville City Schools and the Davidson County Schools, Nashville, Tennessee, were selected as the study situation. These schools had similar resources for providing music education experiences and leadership that was interested in research that might lead to the improvement of their music programs.

Fourteen secondary schools, equal in grade structure (7-12), were selected as the primary study group from the thirty-one secondary schools surveyed. They contained 3,407 music students and 30 music teachers.

Certain integrants were hypothesized to be related to the extent of music participation. The relationships were studied using correlational techniques. The coefficients of correlation were tested for statistical significance using the 5 per cent level of confidence as the minimum standard.

Conclusions

The following conclusions are submitted as integrants of music education which are related to participation in music at the secondary level.

1. In comparison with low participation schools, music teachers in high participation schools had (a) taught in the same schools more years, (b) more advanced degrees, and (c) more total years teaching experience.
2. Students with piano background tend to stay in the music program throughout the secondary school.
3. "Melody Instrument" background by students in the elementary school increased the participation in the secondary school music program. This "melody instrument" background did not necessarily maintain this degree of participation.
4. In the opinion of the music teachers, scheduling of the music curriculum, more than any other factor, limited the degree of participation in the secondary music program.
5. In schools with high participation in the music program, the ratio was approximately one music teacher for every 300 students in the school.
6. Involvement by music students in the community music program, particularly church choir, was related to participation in the secondary school music program.

Implications

The implications of this study are important for the school administrator and the music educator.

1. Good music programs in the secondary school takes time to develop. The music program is enhanced by retaining a well-qualified music teacher in the same school for a period of years.
2. Piano experiences should be part of the elementary music program. Private piano study should be encouraged by teachers and administrators.
3. "Melody Instruments" such as, song flute, tonette, bells, recorder, etc., should be part of the elementary music program.
4. There is a need for development of scheduling techniques that will allow all children, that so desire, to participate in music.
5. In secondary schools where administrators want a high degree of participation in music, one music teacher should be hired for each 300 students enrolled.

6. Participation by students in community music activities, particularly church choir, should be encouraged by administrators and music educators.

Microfilm $2.75; Xerox $4.80. 94 pages.

THE CONTENT EVALUATION OF SELECTED MUSIC PROGRAMS PRODUCED FOR THE NATIONAL EDUCATIONAL TELEVISION AND RADIO CENTER

(L. C. Card No. Mic 61-1785)

Donald Joseph Shetler, Ed.D.
University of Michigan, 1961

The purpose of this study was to provide for production agencies and music educators useful content evaluations of selected music programs produced for educational television and recommended for instructional use in music classes. The need for the study arises from the fact that a large number of such programs are now available for classroom use on television and as 16-mm motion pictures.

Programs evaluated were on films and kinescope recordings produced for the National Educational Television and Radio Center program service to educational television stations. Students and teachers from the National Music Camp, Interlochen, Michigan, evaluated the programs during regular classes.

Special evaluation questionnaires were developed by the author for the project. A research grant awarded by the NET helped to defray the cost of printing the forms and the preparation of the resulting data from the project. All forms and questionnaires, and a description of the evaluation procedure, are included in Chapter II of the dissertation.

Evaluations of forty programs from nine series are reported in detail in Chapter III through Chapter X. Each chapter contains a description of a series, individual program descriptions, comments on the classes contributing evaluations, and the responses to the questionnaire.

General conclusions drawn from the study were these: (1) The wide age range of evaluators and the variety of music classes represented in the population brought both depth and breadth to the results of the study. (2) Evaluators rated musical performance highly in most programs. (3) Teachers and students expressed varying opinions of subject matter organization in the programs. All agreed that certain programs were deficient in this respect. (4) Students tended to disagree with their teachers and each other in their evaluations of specific production features, but they did agree on major strengths and weaknesses of programs. (5) Poor reproduction of recorded sound was cited as the weakest feature of most programs. (6) Teachers stated that they would use such programs in music classes during the year if they were available. (7) Many valuable suggestions were offered for improvement of existing series and for the production of new series of music programs for instructional use. (8) Very few students or teachers had seen the programs although many of them have been available on film for over two years. No teacher had used the programs in his teaching prior to the evaluation project.

Microfilm $4.50; Xerox $15.75. 349 pages.

A STUDY OF THE EFFECT OF LARGE-GROUP VOCAL TRAINING ON THE SINGING ABILITY OF NURSERY SCHOOL CHILDREN

(L. C. Card No. Mic 61-1667)

Robert Barton Smith, Ed.D.
University of Illinois, 1961

The purpose of the study was to plan, implement and report on the effectiveness of a specialist-directed vocal skill-centered music program for two nursery school groups. The purpose resulted from the conflict found between published research results and professional literature suggestions in the field of nursery school music. Research findings indicated the appropriateness of vocal training at the nursery school level, which led the investigator to hypothesize that:

> a vocal skill-center program conducted by a music specialist is both applicable and appropriate to a nursery school situation.

The Junior and Senior groups at the University of Illinois Child Development Laboratory were trained in vocal skills for two sixteen-week semesters. The Junior Group was composed of twenty three-year-old youngsters while twenty-one four-year-old children formed the Senior Group. Large-group training techniques were a feature of the study in contrast to earlier research in which investigators trained only one or two children at a time. Three vocal tests were administered to members of both groups during the training period.

Large-group vocal skill-centered training proved appropriate for both groups although the following differences were observed regarding both the speed and the extent to which the groups benefited from specialist training:

1. Thirteen Junior Group children completed both the training and the three vocal tests. Twelve learned to sing tunefully from Middle C up to A while the remaining child achieved tuneful reproduction from Middle C up to F. Both semesters of training were required to enable the younger group to reach this level of proficiency. Junior Group members did not respond to training designed to help them learn to sing tunefully in a higher range.

2. Sixteen Senior Group children completed both the training and the three vocal tests. The remaining five left the laboratory after one semester of training and were replaced by other children. The group responded more quickly than the younger group to lower range vocal training. Fourteen group members were completely accurate in the lower range after one semester of training and one of the two remaining children achieved comparable accuracy by the end of the second semester. The older group did improve as a result of upper range (A up to D^1) training but only seven achieved the level of accuracy displayed in the lower range.

Microfilm $2.75; Xerox $6.40. 134 pages.

THE CARDIOVASCULAR PHARMACOLOGY OF TERTIARY-BUTYLAMINE AND RELATED ALIPHATIC AMINES

(L. C. Card No. Mic 61-1717)

Thomas Baum, Ph.D.
University of Michigan, 1961

The investigation is divided into three major groups: 1. general pharmacology of t-butylamine (TBA), 2. mechanisms of action of TBA and 3. the structure activity relationships of the cardiac actions of aliphatic amines. The pharmacology of TBA was studied because: 1. the pressor response to TBA appears to be qualitatively different from that of other butylamines, 2. TBA shares structural and pharmacological properties with tetramethylammonium and tetraethylammonium and 3. although chemical references to TBA first appeared in the literature of the last century, no pharmacological data could be found on the compound.

Administration of TBA to unanesthetized dogs results in mydriasis, loss of light reflex and changes in heart rate. Profound central nervous system activity does not seem to be an attribute of the compound.

Initial intravenous administration of TBA (0.1 to 1 mg/kg) to anesthetized dogs results in depressor or biphasic responses. Five mg/kg, or more, of TBA consistently elevates blood pressure although biphasic responses frequently occur with 5 mg/kg but not with 10 mg/kg or more. TBA causes positive inotropic and chronotropic effects in several preparations. It is concluded that an increase in cardiac output is partly responsible for the pressor effect of the compound in the anesthetized animal.

The pressor response to TBA appears to be peripheral in origin and not due to stimulation of the central nervous system or sympathetic ganglia. Data obtained with adrenergic blocking agents suggests that adrenergic mechanisms are involved in the cardiovascular effects of TBA. These effects appear to be mediated via indirect mechanisms, i.e., the release of endogenous catecholamines. The adrenal medulla, other chromaffin tissue, the heart and vascular stores of catecholamines are probably the sources of the released material. Potentiation of circulating catecholamines may also contribute to the pressor effects of TBA.

Tachyphylaxis has been demonstrated to the pressor effects of large doses of TBA (25 mg/kg or higher). The occurrence of cross-tachyphylaxis between TBA and two phenylalkylamines, amphetamine and ephedrine, has been shown to be incomplete. Large doses of TBA block autonomic ganglia and stimulate isolated intestinal preparations.

The inotropic potency of thirty-six aliphatic amines, phenylalkylamines and related hydrazines was compared in the cat papillary muscle preparation. It was concluded that: 1. qualitative differences in cardiac activity do not account for the depressor effects of low molecular weight aliphatic amines, 2. increasing the length of the main carbon chain up to n-hexyl and n-heptylamine enhances potency, 3. alpha-monomethyl substitution does not appear to enhance cardiac potency, 4. alpha-dimethyl substitution increases the activity of the lower chain length aliphatic amines, 5. carbon chain length is probably more important in determining the potency of higher members of the series, 6. the addition of groups larger than methyl or dimethyl substitution of the nitrogen atom reduce activity, 7. the more potent aliphatic amines are about as active as the phenylalkylamines and 8. aliphatic amines are more potent than the corresponding hydrazines that were examined. Microfilm $2.75; Xerox $6.80. 143 pages.

MECHANISMS OF TRIETHYLTIN TOXICITY

(L. C. Card No. Mic 61-1768)

Kenneth Edwin Moore, Ph.D.
University of Michigan, 1961

The purpose of this study was to determine the mechanism of toxicity of triethyltin, an extremely poisonous organotin compound. The study was divided into three general areas: 1) the distribution of triethyltin in the whole animal, 2) the effect of triethyltin on certain physiologically active amines which are stored in the tissues and 3) the effect of triethyltin on the energy transformations that occur in the living cell.

The initial studies with triethyltin were concerned with the gross observation of the toxic symptoms that occur in rats, rabbits and dogs. They revealed an initial period of central nervous system depression followed by hind-limb paralysis and death. The symptoms observed in the animals were similar in many respects to those reported in humans following accidental ingestion of triethyltin. These symptoms seemed to be the result of central actions of the compound.

A colorimetric method for the measurement of triethyltin in animal tissues was developed. Following injection into rats, triethyltin is located in highest concentration in the blood, followed in order of decreasing concentrations by liver, kidney and brain. The compound remains in the liver and kidney for at least three weeks, the concentration in the blood declines more rapidly. The concentration of triethyltin that was found in the tissues was used as a criterion for subsequent in vitro biochemical studies.

Several symptoms of triethyltin toxicity (piloerection, hyperglycemia and central nervous system depression) prompted the study of the effects of this compound on the catecholamine concentrations in the tissues. A modification of the trihydroxyindole fluorimetric method of measurement was developed. Triethyltin causes a release of catecholamines from the brain and adrenal medulla. The norepinephrine content of the heart is not markedly affected but the epinephrine content is increased, the consequence of the adrenal release. Spinal cord transection and ganglionic blockade prevent the release of amines from the adrenal medulla without affecting the catecholamine release in the brain, indicating that the adrenal release is centrally

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

mediated. The brain concentration of 5-hydroxytryptamine is also reduced following triethyltin administration.

The third part of this investigation was directed towards an in vitro biochemical study of triethyltin effects. This compound interferes with the energy transformations that occur in the tissues. Rat brain slice respiration is inhibited by in vitro and in vivo administration of triethyltin. This compound, when added in vitro, also uncouples oxidative phosphorylation of brain and liver homogenates and mitochondria. Both the magnesium and the 2,4-dinitrophenol activated adenosine triphosphatases of isolated mitochondria are inhibited by low concentrations of triethyltin.

Triethyltin induces swelling of isolated rat liver mitochondria. This effect is not seen with brain mitochondria. The properties of triethyltin which enable it to produce mitochondrial swelling were studied in detail in the light of recent discoveries concerning this phenomenon.

The relationship between the gross picture of triethyltin toxicity and the biochemical alterations produced by this compound are discussed. The release of amines from their tissue stores, the depression of brain slice respiration and the ability of this compound to uncouple oxidative phosphorylation may all play a role in altering normal cellular functions which lead to the symptoms of triethyltin toxicity. Microfilm $2.75; Xerox $5.20. 105 pages.

THE MECHANISM OF THE REDUCTION IN CARDIAC OUTPUT BY HEXAMETHONIUM

(L. C. Card No. Mic 61-1820)

Ben George Zimmerman, Ph.D.
University of Michigan, 1961

This investigation deals with the mechanism of the reduction in cardiac output in dogs by the ganglionic blocking agent hexamethonium. The blockade of sympathetic tone to the veins resulting in venous pooling, was thought to cause the decreased cardiac output. In order to eliminate the effect of venous pooling upon the heart, a pressure stabilizing device was used to maintain a constant cardiac filling pressure. The stabilizer established a constant filling pressure by way of a catheter which was passed into the right atrium of intact closed-chest dogs. Hexamethonium administered to normal anesthetized animals with constant cardiac filling pressure caused a decrease in cardiac output and blood pressure.

The cardiac output of a heart-lung preparation was not changed by cross-circulating the reservoir of the heart-lung with the blood of a donor dog which received the ganglion blocking agent. This experiment indicates that a cardiac depressant substance is not released by hexamethonium. The suppression of the release of a cardiac stimulatory substance into the blood stream by hexamethonium is also ruled out as a possible mechanism for the reduction in cardiac output.

When hexamethonium was administered to animals which had undergone chronic cardiac sympathectomy, the cardiac output was increased, but the blood pressure was diminished. Sham-operated dogs responded to the ganglion blocking agent as did the normal animals. Therefore, the blockade of tonic sympathetic impulses to the heart is indicated to be the mechanism responsible for the decreased cardiac output following hexamethonium. A decrease in both heart rate and stroke volume was shown to contribute to the cardiac output decrement.

Minimally effective doses of hexamethonium decreased blood pressure before affecting the cardiac output. Thus, the sympathetic tone to the peripheral vasculature appeared to be more sensitive to the blockade than that to the heart.

Spinal anesthesia in dogs with constant cardiac filling pressure resulted in similar cardiovascular effects as ganglion blockade, whereas spinal transection did not acutely lower blood pressure or decrease cardiac output. Microfilm $2.75; Xerox $4.60. 90 pages.

PHILOSOPHY

PSYCHOLOGY AND SENSE-DATA

(L. C. Card No. Mic 61-1724)

Brenda Margot Brush, Ph.D.
University of Michigan, 1961

The purpose of this essay is two-fold: 1) To examine and criticize two examples of sense-datum theories of perception--those of H. H. Price and C. D. Broad--in the light of the data from psychology on the phenomena of constancy (an example of this phenomenon being the fact that a penny looks round from all angles of regard if the observer has a naive attitude). 2) To develop the outlines of a theory of everyday perception which is acceptable philosophically and which is consistent with the data from the psychologist's laboratory.

The material used from psychology can be divided into three: 1) the experimental results on shape, size and color constancy, 2) Kohler's theory of the given, as explained in his Gestalt Psychology, and 3) James J. Gibson's theory of perception as explained in The Perception of the Visual World.

I show that the theories of perception of both Broad and Price are inadequate on empirical grounds; in particular, the typical sense-datum theory analysis of everyday perception cannot account for the phenomena of constancy, as the analysis offered really covers quite different phenomena.

I try to show that any attempt to separate out a given element in perception by using the criterion that such an element is unlearned is doomed to failure. My argument is based on certain facts about the development of perception

in infants and children and on the fact that an hypothesis that such-and-such element in perception is unlearned is difficult, if not impossible, to test. I also show that using the criterion of indubitability for a given element is more likely to force one into speaking of physical objects as given rather than of sense-data.

The theory which I develop is as follows:

I The Given: From Gibson's work it is seen that the notion of retinal stimulation can legitimately be broadened to include aspects of perception that have traditionally been thought to be added by the mind. Two kinds of stimulation are indicated and these provide the physiological bases for perception of what I call the "painter's view" and for perception of the real sizes, shapes and positions of physical objects. I claim that both the painter's view and the real properties of the physical world are given.

II Since physical objects are given, there is no analogue to that part of a traditional theory of perception which states how it is we "go from" the given to perception of physical objects.

III I show that admitting the existence of the painter's view answers certain questions that the sense-datum philosopher would ask and at the same time avoids the epistemological difficulties attached to admitting the existence of sense-data.

The theory developed applies only to ordinary perceptual experiences and the experiences that we have when we try to see the painter's view. It does not cover perceptual situations in which subjective factors distort what is seen, but I don't think that any one theory could explain all kinds of perception.

Microfilm $2.75; Xerox $9.45. 206 pages.

REASONS, CAUSES, AND FREE WILL.

(L. C. Card No. Mic 61-1428)

Carl Allen Ginet, Ph.D.
Cornell University, 1960

This thesis aims to clarify the free will problem by attacking that common conception (described in Chapter I) which regards it as arising from the supposed fact that human actions result from necessitating causes--volitions or decisions or choices or intentions--which themselves have causes--desires, motives, and beliefs of various kinds--which also have causes, and so on; so that all human actions are ultimately caused by conditions that are beyond the control of the agents. The solution offered by many who conceive the problem in this way is that it does not matter to the freedom of the action that the causal determinants of it go back beyond the agent's control, as long as it is true (according to supposed causal laws governing volitional processes) that if only the motives and volition of the agent had been different, the action would have been different. Then we can say that the agent chose his action and that it could have been altered by persuasion.

The attack consists, first, in denying that volitions, intentions, motives, beliefs, and psychological attributes in general are causes of behavior in the same sense as physical processes (e.g., heating a metal) are causes of their effects (e.g., expansion of the metal). This denial is supported by elucidating (in Chapter II) three essential features of causal connection, viz., its universality, contingency, and empirical necessity, and by showing (in Chapter III) that the connection between a disposition, or a desire, or an intention, or indeed any psychological attribute and the behavior that manifests it cannot possibly have all three of those features. The following points are also made: explanations and predictions based on dispositional properties are not necessarily also based on beliefs in causal connections that account for the dispositions; explanations and expectations concerning human behavior that are based on voluntary dispositions or character traits cannot represent beliefs in causal connections between the experiences producing the dispositions and the behavior manifesting them; and the fact that a certain psychological attribute expresses itself in certain kinds of behavior and not in others is not a matter of contingent causal connection but of the concept of that psychological attribute.

The kind of explanations appropriate to free and responsible actions--explanations in terms of the agent's reasons--are (in Chapter IV) characterized and distinguished from other kinds of psychological explanations. Two arguments are given that explanations of this kind are not causal. In the course of these it is contended that the proposition that volitions (choices, decisions) are causally necessitated--an accepted datum of the mistaken conception of the free will problem--is implicitly self-contradictory; and that an agent cannot be mistaken at the time of acting as to what reasons he is acting for (although he may be mistaken in believing that his reasons are all that have led him to want the action), unless he is mistaken also in thinking that he is choosing his action.

Finally (in Chapter V) it is argued that it is an empirical question whether there exist any freely willed human movements (i.e., willed or chosen movements, i.e., ones with explanations in terms of the agent's reasons). The notion of a causal connection makes it logically impossible for anyone to choose to allow a cause to be accompanied by its effect. This yields the consequence that the proposition that there are no human movements that are chosen would be entailed by the hypothesis that there is some time before the occurrence of every human movement that is both a time when the agent had not yet chosen the movement and a time when none of a set of conditions causally necessitating the movement was any longer avoidable by him. It is argued that this hypothesis is empirically meaningful and not ruled out by obvious facts.

Microfilm $2.75; Xerox $9.00. 199 pages.

THE PROBLEM OF CERTAINTY IN ENGLISH THOUGHT FROM CHILLINGWORTH TO LOCKE

(L. C. Card No. Mic 61-1938)

Hendrik Gerrit Van Leeuwen, Ph.D.
State University of Iowa, 1961

Chairman: Professor Richard H. Popkin

The aim of this study is to present an historical account of the solution to a problem concerning the certainty of knowledge developed in England between 1640 and 1690.

It begins with a theological controversy, showing that its resolution influenced the growth of a non-metaphysical, anti-rationalistic, and moderately sceptical scientific outlook. It is shown that in the theological and scientific movements of the period a deliberate effort was made to avoid both dogmatism with its claim to absolute certainty and scepticism with its denial of the possibility of any knowledge whatever. A detailed account is given of the attempt to develop a theory of knowledge which, albeit moderately sceptical, would justify scientific investigation.

The solution to the problem of certainty arose from a controversy between Catholics and Protestants concerning what beliefs are necessary for salvation. Each side claimed its doctrines to be the necessary ones, and the question then arose by what criterion or rule of faith one could decide with certainty what doctrines were necessary. The Protestant solution to the controversy--its theological merits are not discussed--was that theological problems are to be solved in the same way practical problems of ordinary life are solved by a reasonable person. The assurance of common sense about everyday affairs is made the basis for settlement of perplexities about religion. The view is developed that there are several levels of certainty, ranging from absolute certainty in the case of mathematical and metaphysical principles, to moral certainty in the affairs of commerce, travel, science, and religion, down to mere probability; each level of certainty is to be determined by a particular kind of evidence. It is asserted that an exact proportionality must be maintained between subject matter and evidence. One is to accumulate such evidence as is available and base his degree of certainty thereupon. The view, in addition to proposing reservation in judgment until all available evidence has been examined, also contains a fundamental scepticism concerning man's knowledge of the nature of the real.

In connection with the religious controversy the views of two liberal Anglican clergymen, William Chillingworth and John Tillotson, are examined and found to contain a somewhat rudimentary formulation of the theory of certainty. Next, the views of some early members of the Royal Society, John Wilkins and Joseph Glanvill, are investigated to see how the theory initially stated in the religious context was secularized. Following this, an attempt is made to show how the theory was applied by Robert Boyle in the context of bona-fide scientific investigation. The views of Sir Isaac Newton on scientific certainty are also presented, though with the suggestion that they were not original with him but simply a continuation of views stated earlier, and that he is not the person responsible for setting the temperament and method of the Society. Finally, the generalized-philosophical version of the theory, as set forth by John Locke in An Essay Concerning Human Understanding, is presented. By way of conclusion, Hume's attempt to undermine the theory is sketched.

It is shown, as a subsidiary thesis, that the view that Bacon is the spiritual father of experimental science with respect to aims and method, though initially plausible, must be rejected as false. Though the early members of the Royal Society emulate his view that knowledge is for the improvement of human life and praise his anti-scepticism, they reject the view that scientific investigation yields absolute certainty about the structure of nature; thus, Bacon's views concerning the certainty of scientific knowledge are at odds with those of the more influential of the early members of the Royal Society.

Microfilm $3.80; Xerox $13.30. 294 pages.

PHYSICS, GENERAL

A "DISTORTED" WAVE CALCULATION OF THE CAPTURE OF ELECTRONS BY PROTONS PASSING THROUGH ATOMIC HYDROGEN

(L. C. Card No. Mic 60-6170)

Robert Harold Bassel, Ph.D.
University of Pittsburgh, 1960

The distorted wave method, in which distorted waves replace plane waves in the matrix elements for the collision amplitude, is given a vigorous formulation for arbitrary rearrangement collisions. The formulation enables removal of unphysical and other unwanted interactions from the "perturbation" Hamiltonian, dependence on these interactions being absorbed into the wave functions. The procedure is applied to the problem of electron capture by protons in atomic hydrogen, eliminating explicit dependence on the proton-proton interaction. In a first order calculation all dependence on the proton-proton interaction vanishes from the matrix element. Numerical results of the first order calculation are in good agreement with experiments from 35 to 200 kev. Despite this agreement and the agreement of previous calculations, it is felt the charge transfer process is still not well understood. Microfilm $2.75; Xerox $3.00. 58 pages.

INFRARED SPECTRA OF METHYL BROMIDE AND METHYL IODIDE IN THE 2.2 MICRON REGION

(L. C. Card No. Mic 61-1945)

Robert Glenn Brown, Ph.D.
Michigan State University, 1959

Major Professor: T. H. Edwards

The absorption spectra of methyl bromide and methyl iodide in the 2.2 micron region have been investigated under high resolution (≈ 0.07 cm^{-1}). Spectra were obtained with a self-recording vacuum spectrometer of the Pfund type, using a blazed 400 line/mm echelette grating

and a cooled lead sulfide detector. Spectral calibration was achieved using simultaneously recorded Edser-Butler bands from a Fabry-Perot etalon to interpolate between argon emission line standards.

Bands observed between 4200 cm^{-1} and 4500 cm^{-1} were assigned to $\nu_2+\nu_4$, $\nu_4+\nu_5$, and $\nu_1+\nu_3+\nu_6$ for methyl bromide; and to $\nu_2+\nu_4$, $\nu_4+\nu_5$, $\nu_1+\nu_5$, and $\nu_1+\nu_3+\nu_6$ for methyl iodide. One weak band in the methyl iodide spectrum was not assigned. All the bands observed exhibit the characteristic features of perpendicular bands.

Sufficient rotational fine structure was resolved in three of the bands ($\nu_1+\nu_3+\nu_6$ of methyl bromide and $\nu_2+\nu_4$ of both methyl bromide and methyl iodide) so that the analysis could be carried out using the sharp single lines of the P and R series of the various sub-bands, rather than the unresolved groups of lines which form the Q branches. These analyses yielded values for B", B', and D_K as well as for ν_o, A' and ζ_i. In addition, series of R branch lines were identified for four sub-bands of $\nu_1+\nu_3+\nu_6$ of methyl iodide.

Values of B' obtained from the various sub-bands exhibit a variation with K. For the bands $\nu_2+\nu_4$, the variation is nearly symmetric about the band center. To attribute the variation in these cases to centrifugal distortion requires changes in D_{JK} of 5% and 200% for methyl iodide and methyl bromide respectively. For the bands $\nu_1+\nu_3+\nu_6$, the variation is asymmetric and could not be interpreted solely in terms of centrifugal distortion. In the most extreme case, $\nu_1+\nu_3+\nu_6$ of methyl iodide, B' varies from a value less than B" to a value greater than B". In both bands, the variation correlates with the observed shape of the Q branch envelopes.

The bands assigned as $\nu_1+\nu_5$ and $\nu_1+\nu_3+\nu_6$ in the methyl iodide spectrum exhibit anomalous spacing and intensities. In addition, the shapes of the Q branch envelopes vary abnormally. Observed anomalies also include a split Q branch in $\nu_1+\nu_3+\nu_6$ of methyl bromide.

Microfilm $2.75; Xerox $4.80. 95 pages.

PHENOMENA RELATED TO THE ANOMALOUS DIELECTRIC CONSTANT OF QUARTZ

(L. C. Card No. Mic 61-1918)

Jason Arundel Ellis, Ph.D.
State University of Iowa, 1961

Chairman: Professor E. P. T. Tyndall

In this investigation the anomalous dielectric constant of crystal quartz and related behavior have been studied by both new and previously used experimental techniques. The results of certain of these experiments are interpreted as contradicting the generally accepted simple space charge model.

The absorption current is orders of magnitude greater for fields parallel to the principal direction of the quartz lattice than for fields perpendicular to it. The simple space charge model is applied to the field parallel case. For this direction the quartz has an open structure. There are several types of centers which might contribute free charges.

In the simple space charge model absorption current and thus the anomalous dielectric constant are attributed to the motion of charge within the quartz. It is assumed that (1) only one type of ionization is present and thus at most two carriers, and (2) the following are functions only of temperature: diffusion coefficient, mobility μ, coefficient α and coefficient β. When there is no net flow of carriers, the concentration of positive "ions" n_+ and the concentration of negative "ions" n_- are assumed to change as follows: $\dot{n}_+ = \dot{n}_- = \alpha n_s - \beta n_+ n_-$ where n_s is the concentration of centers from which the "ions" are derived.

It was found that the results from two types of experiments were not quantitatively compatible when interpreted using the simple space charge model. The experiments differ in procedure but use the same experimental set up. Two capacitors were made. For each, the dielectric was a plate 2 cm square and 1 mm thick, so cut from a single quartz crystal that the square faces were perpendicular to the principal direction.

As found by others, application of constant dc potential across a capacitor produced anomalous charging current (absorption current). The following effect, however, does not seem to have been reported by previous investigators: If there was sufficient time between experiments there was at first an increase in absorption current. This was then followed by the expected decrease in current. At 30°C the increase persisted for about 10 minutes and at 50°C for about $\frac{1}{2}$ minute. Increases were observed for 45, 90, and 300 volts but not for 6 volts.

The average conductivity $\bar{\sigma}$ within the sample can be calculated from the current response to an abrupt voltage change. Using flip-flop pulses applied previous to and during a 300 volt charging the $\bar{\sigma}$ was found to increase to 3.0 times its initial value. The rate of increase was quite rapid relative to the leisurely decay of artificially produced conductivity as observed by Schaposchnikov. This was surprising since in the simple space charge model (1) the average conductivity is proportional to the carrier population, (2) the rate of increase of carrier population cannot exceed the rate at which new carriers are produced during equilibrium, (3) the rate of decay observed by Schaposchnikov should exceed this equilibrium rate.

To further investigate this suspected lack of agreement with the simple space charge model a second type of experiment was performed. The conductivity was raised to over three times its equilibrium value by an electrical shaking technique. The conductivity was then periodically measured using a flip-flop pulse.

It was found that under the simple space charge model the rate of increase in carrier population during the charging process was at least an order of magnitude greater than the maximum possible rate of formation of new carriers as determined by the decay of superfluous conductivity observed after the electrical shaking.

Microfilm $2.75; Xerox $3.80. 68 pages.

QUANTUM MECHANICAL POTENTIAL SCATTERING BY A POSITIVE DEFINITE VARIATIONAL PRINCIPLE

(L. C. Card No. Mic 61-1685)

George H. Goedecke, Jr., Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: E. Brown

A minimum variational principle for inhomogeneous equations is brought to new application in quantum mechanical potential scattering problems, and compared with the Kohn and Schwinger principles. This minimum principle is referred to here as the error method, since it acts to minimize a positive-definite integral which depends on the error resulting from use of an inexact trial function.

In many scattering problems, several different variational principles may be used to fix the adjustable parameters in the trial wave functions; each method fixes these parameters to different values. These fixed trial functions may be inserted into any one of a number of certain integral expressions, each of which then gives a different approximation to the desired phase shift or scattering amplitude. The Kohn and Schwinger variational functionals themselves have the property of yielding such approximations, but in general they give little or no indication of the errors involved. The error method variational functional does not directly yield these approximate values, but it always provides an indication of the error in each.

Our calculations suggest that using the error method to fix the trial functions, and then inserting them into a stationary functional, (such as the Kohn or Schwinger functional), which also yields the desired approximations, is more dependable than using the Kohn, Schwinger, or similar principles alone.

Our study shows that the Kohn, Schwinger, and error variational functionals can be obtained from a generalized functional, under different choices for certain weighting operators contained in the latter. The Kohn functional is shown to consist of two separately stationary terms. The first term is similar to the error functional; the second has the Schwinger functional as its amplitude-independent form.

Our results indicate that an appropriate multiplicative weighting operator in the error functional can lead to greater accuracy.

In the partial wave treatment of the scattering problem, our work shows that the phase shift of each partial wave is simply related to the necessarily constant ratio of its imaginary to real parts. This result holds at least for potentials have only one axis of symmetry, as well as for spherically symmetric potentials.

Our study shows that the Kohn, Schwinger, and error variational principles are all applicable to the partial wave equations for non-spherical potentials, but that the Kohn and Schwinger functionals no longer directly provide approximations to the desired phase shifts. As an example of the use of the error method for these equations, a sample numerical calculation is performed for the low-energy scattering from an oblate spheroidal Gaussian potential. For the parameters used, the total cross-section increases as the incident direction runs from the symmetry axis to the symmetry plane.

Microfilm $2.75; Xerox $4.40. 81 pages.

THE KINETIC THEORY OF FULLY IONIZED GASES

(L. C. Card No. Mic 61-1743)

Ralph Lewis Guernsey, Ph.D.
University of Michigan, 1961

It has long been known that the Boltzmann transport equation is inadequate for the description of irreversible processes in ionized gases. The difficulty arises from the long-range nature of the Coulomb interactions, which precludes the assumption (basic to the Boltzmann theory) that only binary collisions are important. It is the purpose of this investigation to derive the kinetic equation which replaces the Boltzmann equation for a fully ionized gas.

The approach is a modification of that employed by Bogolubov in obtaining the Boltzmann equation and its generalizations for an ordinary gas from the Liouville equation. As an illustration of the method and the type of results to be expected, the theory of ionized gases (and ionic solutions) in equilibrium is presented in Part I of the dissertation.

In Chapter I the earlier treatment of the equilibrium theory, particularly that of Debye, are reviewed and criticized. The orders of magnitude of various parameters occurring in the theory are also tabulated for typical temperatures and densities.

Chapter II deals with the Mayer theory of ionic solutions. The results are generalized to include expressions for the distribution functions, and some explicit calculations are made for the case when the short range forces are of hard sphere type.

In Chapter III the same expansion is derived by an integro-differential equation method which has the advantage of being readily generalizable to non-equilibrium situations.

Chapter IV develops the general formalism for obtaining the kinetic equation to an arbitrary degree of approximation. The zeroth approximation (in a parameter which is a measure of the field strength) is shown to be the familiar Landau-Vlasov equation (generalized to include an arbitrary number of types of ions) which is discussed in some detail. For the first approximation, an integral equation and an explicit expression as an infinite sum are derived.

Chapter V treats the important special case of the uniform state. In this case the integral equation can be solved to give explicit expressions for the s particle distribution functions and the time derivative of the one particle distribution functions, involving only a finite number of integrals. The equation for $\frac{\partial F_1}{\partial t}$ (kinetic equation) is shown to have the following properties: 1) the H-theorem is satisfied; 2) the equation may be written formally in the Fokker-Planck form; 3) the equation may be expressed as a "weak field" approximation to a Boltzmann equation with an effective binary interaction potential which depends on the momentum of the particles and on the one particle distribution functions. In the limit of zero momentum, the effective potential reduces to the "shielded Coulomb" or Debye potential familiar from the study of the equilibrium state.

Microfilm $2.75; Xerox $6.60. 136 pages.

A CONTRIBUTION TO THE STUDY OF THE N^{14}–N^{15} HYPERFINE STRUCTURE

(L. C. Card No. Mic 61-1623)

William Weller Holloway, Jr., Ph.D.
University of Illinois, 1961

The hyperfine structure of atomic nitrogen has been studied for the two stable isotopes, N^{14} and N^{15}. The technique used in the experiment was to orient the nitrogen continuously through spin exchange with optically oriented cesium. As a result of these measurements, the following values were obtained:

$$|A(14)| = 10.450\ 928 \pm .000\ 045 \text{ Mc/sec.}$$

$$|B(14)| = .000\ 005 \pm .000\ 035 \text{ Mc/sec.}$$

$$|A(15)| = 14.645\ 475 \pm .000\ 050 \text{ Mc/sec.}$$

Using these experimental results and the nuclear g-values obtained by Anderson et al. the hyperfine structure anomaly was calculated to be

$$\Delta = (1.000 \pm .006) \times 10^{-3}.$$

Neither a pressure shift nor a temperature shift was observed. The results are discussed in relation to a recent theoretical calculation of the hyperfine structure constant of nitrogen by Das and Mukherjee. The experimental results are consistent with the theoretical implications. A brief discussion of optical pumping and spin exchange as related to the present experiment is included.

Microfilm $2.75; Xerox $4.20. 76 pages.

ANTIFERROMAGNETIC RESONANCE IN MnF_2

(L. C. Card No. Mic 61-863)

Fred M. Johnson, Ph.D.
Columbia University, 1958

Measurements of the antiferromagnetic resonance frequency, $\gamma(T)$, were made on single crystal slabs of MnF_2 in the frequency range 96 to 247.2 kMc/sec and at temperatures, T, ranging from 4.2°K to 64°K (T_N = 67.7°K). The results are in general agreement with the resonance relations derived for antiferromagnetic materials by Nagamiya, Keffer and Kittel and others. At low temperatures, values of $\gamma(T)/\gamma(O)$ and $\gamma(O)$ are consistent with spin-wave method calculations of the sublattice magnetization and of the value and temperature dependence of the anisotropy energy. This agreement indicates almost complete correlation of adjacent electron spins in the low temperature range as predicted from spin-wave theory.

From the AFMR measurement of $\gamma(O)$=261.4±1.5 kMc/sec and Oguchi's calculation of H_A, $z|J|$ is 3.94 X 10^{-15} erg, in agreement with other determinations. AFMR line widths were measured from 4.2°K to 64°K. The observed asymmetric line shapes are satisfactorily accounted for as arising from a mixing of absorption and dispersion and from reflections. A simplified line width theory is given which satisfactorily accounts for the observed line widths except at the lowest temperatures, where a residual width is found. Finally, AFMR measurements on two crystals, which were grown under different conditions, indicate no difference in resonance frequency or line width.

Microfilm $2.75; Xerox $3.60. 61 pages.

A TRANSPORT EQUATION FOR MAGNETOHYDRODYNAMIC WAVES

(L. C. Card No. Mic 61-1425)

Marvin Mark Litvak, Ph.D.
Cornell University, 1960

We deal with a plasma of electrons and ions at a density of 10^{16} particles per cc and temperature 10^5 to 10^6 degrees K. There is a magnetic field of about 10^4 gauss whose pressure is about 10^1 or 10^2 times larger than the gas pressure.

We limit our attention to physical phenomena occurring over lengths of the order of $r_i = \sqrt{m_i c^2/(4\pi ne^2)}$ which is about one centimeter or about 10^4 times larger than the Debye length. r_i, the largest characteristic length next to the particle mean free path, is the gyro-radius of ions which move at the Alfvén speed, the characteristic speed of magnetohydrodynamic (MHD) flows.

The mean free path for multiple Coulomb scattering, the only particle collision process for these plasma conditions, is large so that diffusion and dissipation processes due to particle collisions are slow. However, experimental evidence exists which indicates high diffusion and dissipation rates. We attribute these processes to the diffusion and randomization of waves which are excited in the plasma.

In particular, the important waves are the fast MHD waves, which are one of the six types of normal waves which we obtain from the Boltzmann equation with a self-consistent Lorentz force and no collision term. The fast waves were derived under the restrictions that the particle thermal velocities are unimportant, that the wavelengths lie between $r_i \sqrt{m_e/m_i}$ and r_i, and that the Maxwell displacement current is small. The fast waves are important because they are not heavily damped and they have phase and group velocities of the order of the Alfvén speed.

Our main effort is to derive a wave transport equation for the fast MHD waves which describes the motion of a wave in a non-uniform medium, the amplification of a wave because of the pressure of the surrounding medium, and the scattering of a wave by other waves. This equation resembles the transport equation for lattice waves in a crystal.

The equations for the structure of a steady MHD shock are derived from the wave transport equation but not solved. The shock model is based on the assumption that behind the steady shock is a distribution of fast waves whose pressure is much greater than the gas pressure. The waves scatter with other waves and provide the entropy increase for the jump of conditions across the shock. The particles become thermalized only some distance further back of the shock by means of damping of wave motion into particle motion. Estimates of relaxation

times for the wave collision processes are made, and an estimate of the shock thickness, as a function of shock velocity, is made assuming that it is a few wave mean free paths. Microfilm $2.75; Xerox $5.00. 98 pages.

EXPERIMENTAL STUDY OF THE DIAMAGNETISM OF THE ELECTRON GAS IN GASEOUS PLASMAS WITH ELECTRON AND NUCLEAR SPIN RESONANCE TECHNIQUES

(L. C. Card No. Mic 61-1642)

Thomas Carlisle Marshall, Ph.D.
University of Illinois, 1961

The diamagnetism of gaseous plasmas is studied both theoretically and experimentally in this work. The theoretical section contains a critique of the several "diffusion" theories of plasma diamagnetism. Attention has been focused on the quantum-mechanical aspects of the problem, which helped clarify certain theoretical issues. It is shown that for strong magnetic fields plasma diamagnetism is not critically dependent on diffusion processes in the discharge, but rather results from an uncompensated microscopic current owing to non-equilibrium phenomena. A theoretical expression for M, the magnetic moment per unit volume of the plasma, which has wide applicability is

$$M = \frac{-nk(T_e + T_i)}{H} \cdot \frac{1}{1 + \frac{\nu_{em}\nu_{im}}{\omega_{He}\omega_{Hi}}} ,$$

where n is the charge concentration, H, the applied magnetic field, T_e and T_i respectively the electronic and ionic temperatures, and ω_{He} and ω_{Hi} the electronic and ionic gyrofrequencies. The electronic and ionic collision frequencies for momentum transfer with neutral gas molecules are ν_{em} and ν_{im}. At the high prevailing temperatures, the collision frequencies for the charged constituents may be neglected.

Experimentally, the diamagnetism of active discharge plasmas was observed by allowing the local magnetic field from an active plasma to influence the spin resonance absorption frequency of a foreign substance located near the plasma. This local field originates in the rotary motion of the plasma charges, and is not caused by the macroscopic discharge tube current.

Experiments performed on low pressure mercury vapor discharge plasmas using an electron spin resonance in DPPH (diphenyl picryl hydrazyl) as a gauss meter showed that the discharge magnetization was linear in the magnetic field for very weak fields, and maximized near 50 gauss with $M \approx -.03$ to $-.06$ erg/cm^3-gauss, depending on the discharge current. This agrees with the predictions of the theoretical formula for M given above. Pulsed Langmuir probe measurements of the electronic energy were in good agreement with that predicted from this equation.

Observation of the phase change in the Larmor precession of protons in a very homogeneous strong magnetic field (1000-4000 gauss), revealed a considerable diamagnetism in a modified P.I.G. (Phillips Ionization gauge) pulsed discharge plasma. This sensitive nuclear resonance gaussmeter technique permitted the observation of plasma diamagnetism to be deferred until the active discharge had terminated. The plasma diamagnetism was a linear function of the discharge power consumption. The largest diamagnetism occurred in an Argon discharge, with $M = -0.32$ erg/cm^3 gauss at 1600 gauss, hence $(nkT_e)_{max} \approx 500$ ergs/cm^3. Additional data was collected for Neon and Helium, in the pressure range from 0.010 to 1.0 mm. The magnetization was found to have roughly an H^{-1} dependence on magnetic field. Measurements of the electron concentration and temperature indicated electronic temperatures of about 50,000 to 100,000°K and charge concentrations of up to 5×10^{13} electrons/cm^3 were achieved.

Irradiation of the active discharge with a high intensity microwave beam (70 watts, 4550 mc/sec) tuned to the electron gyrofrequency caused an increase of energy density of several ergs/cm^3 in the plasma. Detection of the effect relied on the displacement of the proton spin resonance due to the change in local field from the discharge; the sensitivity of this technique is estimated to be one part in 10^6. The microwave method of increasing the energy density in DC plasmas by resonance absorption was found to be several times as efficient as the conventional DC current means for active discharges having initially low energy densities. Additional experimental information on the nature of very narrow electronic cyclotron resonances in a plasma at low gas pressure was gathered. Microfilm $2.75; Xerox $8.60. 189 pages.

THE FARADAY ROTATION AND SOME MAGNETIC PROPERTIES OF EVAPORATED THIN FILMS OF IRON, NICKEL, COBALT, AND GADOLINIUM.

(L. C. Card No. Mic 61-1703)

Frederick James McClung, Jr., Ph.D.
University of Southern California, 1961

Chairman: Professor Holmes

Thin films of iron, nickel, cobalt, and gadolinium have been evaporated and the Faraday rotation measurements were made in the same vacuum system without exposing the films to air. The films were deposited on heated glass as a substrate for the rotation measurements and on carbon films for the electron diffraction measurements. The film thickness was determined by the Tolansky method after the rotation measurements were made.

The system for the measurement of the Faraday rotation is similar to that described by Ingersoll, using a photomultiplier tube as the detector. Narrow pass band interference filters were used to give essentially monochromatic light for the measurements. Rotation constants were obtained at three wavelengths: 5820, 5461, and 4000 Angstroms.

Four iron films were prepared which serve as a check with other work reported in the literature. These films were all deposited on glass at a temperature of approximately 250° C. The average rotation constants were 3.40×10^7, 3.27×10^7, and 1.9×10^7 degrees per meter

at wavelengths of 5820, 5461, and 4000 Angstroms, respectively, compared with Kõnig's results of 3.825×10^7 degrees per meter. The probable error on the rotation constant is ± 5 per cent.

Eight nickel films were prepared under conditions similar to the iron evaporations. The average rotation constants were 1.29×10^7, 1.29×10^7, and 0.86×10^7 degrees per meter at wavelengths of 5820, 5461, and 4000 Angstroms, respectively, compared with 0.89×10^7 degrees per meter reported by Schütz. The probable error on the rotation constants is ± 3 per cent.

Eight cobalt films were prepared under conditions similar to the iron evaporations. The average rotation constants were 3.64×10^7, 3.66×10^7, and 2.44×10^7 degrees per meter at wavelengths of 5820, 5461, and 4000 Angstroms, respectively, compared with 1.98×10^7 degrees per meter reported by Schütz. The probable error on the rotation constants is ± 4 per cent.

No stable films of gadolinium were prepared that were thin enough to get any appreciable optical transmission through, and no rotation was observed in any of the films examined. Resistance monitor checks of the gadolinium films indicated that there was some tendency to react with the residual gas in the vacuum system at a pressure of 10^{-6} mm. hg. This reaction did not have any large effect on films which would show no optical transmissions. For the films which did show a reaction, electron diffraction measurements indicated that what metal was present in the film had condensed in the face-centered cubic structure rather than the close-packed hexagonal structure reported for the bulk material. It is not certain which if either effect noted here is responsible for the lack of ferromagnetism in evaporated thin films of gadolinium.

The electron diffraction studies of iron, nickel, and cobalt show a well-defined polycrystalline film in each case. The iron film appears to condense in the body-centered cubic form, and both nickel and cobalt condense in the face-centered cubic form.

Microfilm $2.75; Xerox $5.40. 108 pages.

CONTRIBUTIONS TO THE THEORY OF HYDRODYNAMIC STABILITY

(L. C. Card No. Mic 61-1781)

Irene Verona Schensted, Ph.D.
University of Michigan, 1961

This investigation deals primarily with the problem of the expansion of arbitrary functions in terms of the eigenfunctions of the linearized stability problem for the plane parallel flow of a viscous incompressible fluid and in terms of the eigenfunctions of the linearized stability problem for the flow of a viscous incompressible fluid through a circular pipe. In Chapter I the differential equations for these two problems are derived and the corresponding eigenvalue problems are formulated. For the case of the flow through a circular pipe only axially symmetric disturbances are considered. In both cases the differential equations are of the fourth order and are not self-adjoint. It is shown in Chapter I that there are an infinite number of discrete eigenvalues to both problems.

In Chapter II a theorem is proved which states that functions which have continuous second derivatives and which vanish at the boundaries but which are otherwise arbitrary may be expanded in terms of the eigenfunctions of the plane parallel flow stability problem. In Chapter III an analogous theorem is proved for the expansion of arbitrary functions in terms of the eigenfunctions of the stability problem for the flow through a circular pipe.

In Chapter IV the expansion theorems are applied to obtain the solution of the initial value problem and of the forced oscillation problem. The application of the expansion theorem to the non-linear problem is also briefly considered.

In Chapter V formulae giving the approximate location of eigenvalues for large Reynolds number for the plane Poiseuille flow case are derived. A brief review of the work of others in locating eigenvalues for plane parallel flows and for the flow through a circular pipe is also given. Microfilm $2.75; Xerox $5.80. 117 pages.

THE THEORY OF Z-CENTERS

(L. C. Card No. Mic 61-1426)

Everett Frederick Sieckmann, Ph.D.
Cornell University, 1960

The effective mass and tight binding (LCAO) approximations have been used to estimate the wave functions and energy levels of electrons bound to impurity ions. The object of the present work was to carefully study the validity of these approximations and extend their range of applicability. The methods developed were applied to a conduction electron which was bound to a doubly ionized calcium ion which replaced a normal potassium ion in a potassium chloride crystal. The general N-body problem was reduced to a one electron problem by the Born-Oppenheimer and Hartree-Fock approximations. The resulting one electron Schroedinger equation for the electron in question was solved approximately by the tight binding method and by the effective mass method. In the tight binding approximation, the ground state wave function was represented as a linear combination of atomic 4S potassium wave functions centered on the positive ion lattice positions. The potential the electron moved in was taken to be the superposition of the Hartree potentials for the free ions. Polarization and ion displacement was taken in account by a modified Mott and Littleton approximation. All overlaps between the ions of the first five shells of nearest neighbors were taken into account, and all three center integrals were taken into account by the Mulligan approximation. Three tight binding approximations were made for the ground state before the estimated screening, lattice polarization, and ion displacements calculated by the Mott and Littleton first order approximation were in agreement with the values calculated from the resulting wave function. The energy level was estimated to be 2.27 ev below the bottom of the conduction band. The ground state tight binding wave functions were expanded in spherical harmonics and it was found that more than 99% of the normalization integral came from the spherically symmetric component. The effective mass of the conduction electron was estimated by a Bloch tight

binding approximation and found to be about 0.82 m_e. The conventional effective mass method gave results which are unreasonable with or without a macroscopic dielectric constant. The effective mass method was studied carefully and it was shown that the potential to be used in the effective mass Schroedinger equation is not the perturbing potential but the average of the perturbing potential computed with the square of the Wannier function for the band as the distribution function. With the effective potential the energy level was found to be 2.16 electron volts below the bottom of the conduction band. The tight binding and modified effective mass methods developed here yield results which are of comparable accuracy if carried out in the true spirit of these methods, if careful attention is given to the lattice polarization, ion displacement, and screening of the impurity ion by the bound electron.

Microfilm $2.75; Xerox $8.00. 171 pages.

X-RAY DIFFRACTION FROM LIQUID NEON

(L. C. Card No. Mic 61-2284)

Dante Stirpe, Ph.D.
University of Missouri, 1961

Supervisor: Professor N. S. Gingrich

A study was made of the x-ray diffraction patterns obtained from neon in both its liquid and vapor phases under twenty-two conditions of pressure and temperature. Seven large-angle scattering patterns were obtained along the liquid-vapor curve from the triple point temperature (24.5°K) to the critical point temperature (44.5°K) using MoKα (.710A) and AgKα (.560A) radiation. Fifteen patterns were taken at small scattering angles in the vicinity of the critical point of neon with CuKα (1.54A) radiation. The large angle patterns obtained at 24.7°K, 25.5°K, 26.6°K, 28.3°K, 33.1°K, 39.4°K, and 44.2°K all show patterns with three well-defined prominences. At the lower temperatures the patterns extend to $s = 11A^{-1}$ and at the higher temperatures to $s = 8.5A^{-1}$. The small-angle scattering patterns taken near the critical point extend from $s = 0.09A^{-1}$ to $s = 1.2A^{-1}$. Aside from one other large-angle scattering pattern obtained using neutrons at a temperature of 26°K, these are the first patterns reported for liquid neon.

Attaining such low temperatures required the use of liquid helium and the construction of a low-temperature cryostat within which liquid helium could be stored for the several hours required to obtain the scattering patterns. A sample cell approximately 1/4" x 1/4" x 3 mm thick was machined from copper and Hysol adhesive was used to attach beryllium x-ray windows to the copper giving a vacuum-tight joint that withstood pressures up to 28 atmospheres. The sample cell, housed within the low-temperature cryostat, was kept at temperatures ranging from 24.7°K to 44.2°K at values constant within 0.1°K for the lower temperatures and 0.2°K for the higher temperatures by an electronic regulating circuit.

After appropriately correcting the large angle diffraction data for effects of background, polarization, absorption, empty cell scattering, and incoherent scattering, these intensity patterns were Fourier transformed to give the atomic distribution function at each of the temperatures. These calculations were performed through use of a Datatron computer at the University of Missouri. The speed of this computer made it feasible to investigate questionable details in the distribution functions arising because of termination errors.

Atomic distributions at all temperatures show a non-discrete first peak indicating that no molecule is formed. For the six temperatures at which the atomic distributions were selected for presentation the positions of the first peaks and the number of nearest neighbors to which the first peak areas correspond are as follows: 24.7°K, 3.14A, 8.4 atoms; 25.5°K, 3.17A, 8.5 atoms; 26.6°K, 3.18A, 8.4 atoms; 33.1°K, 3.20A, 7.7 atoms; 39.4°K, 3.21A, 5.5 atoms; 44.2°K, 3.26A, 4.3 atoms. The atomic distributions were also plotted in reduced variables and compared to the reduced distributions plotted for liquid krypton and liquid argon at approximately the same reduced pressures and temperatures. General agreement with the reduced distributions of liquid krypton was found whereas general disagreement was obtained when compared to liquid argon.

Scattering patterns at small angles show considerable scattering intensity when the pressure and temperature of the neon are very close to the critical pressure and temperature and show much less scattering intensity when the neon pressure and temperature are somewhat removed from the critical values. These scattering patterns were analyzed to obtain an approximate measure of the size of the particles giving rise to the scattering at small angles.

Microfilm $2.75; Xerox $6.40. 134 pages.

A STUDY OF SYSTEMS COMPOSED OF MANY INTERACTING BOSONS

(L. C. Card No. Mic 60-5062)

James D. Talman, Ph.D.
Princeton University, 1959

The theory of systems of many particles satisfying Bose-Einstein statistics is investigated. In contrast to most previous studies, which have been of a variational nature, the treatment is based on perturbation theory. The perturbation theory of such systems, as developed by Brueckner and Sawada,[8] is introduced and is extended to the excited, or phonon, states. The system of bosons interacting through infinite repulsive cores is studied in detail, and it is found that previous treatments of this problem are valid at very low densities only. An analytic solution within a certain approximation is described and is found to fail at a low density. The results of a numerical calculation are then presented and the failure at low density shown to be due in part to the approximation used. It is found that because of the nature of the potential the energy diverges at a very low density; this density is .0843 times the close-packed density. This divergence is due to the unphysical nature of the potential. An improved verskon of the theory is developed and is applied to the hard sphere problem. It is found that this modification produces a considerable change in the ground state energy. This calculation yields an excitation spectrum which is qualitatively similar to the experimental results but is in

quantitative disagreement. In the case in which the potential is partially attractive, producing a bound system, the problem is much more difficult. A possible approach to this problem is discussed and results of a preliminary calculation on a simplified model are presented. These results indicate that the approach may be suitable but the theory requires further development before the approach can be pursued.

Microfilm $2.75; Xerox $5.00. 99 pages.

PHYSICS, ELECTRONICS AND ELECTRICITY

ELECTROMAGNETIC DIFFRACTION BY A PERIODICALLY APERTURED CONDUCTING SCREEN

(L. C. Card No. Mic 61-2100)

Richard Bruce Kieburtz, Ph.D.
University of Washington, 1961

Chairman: Akira Ishimaru

This thesis deals with the electromagnetic diffraction of plane waves by a thin conducting screen containing a doubly periodic array of rectangular apertures. Solutions are obtained by both a rigorous formulation as a boundary value problem and by a variational method.

The specific contributions presented here are twofold. First, a solution is obtained for the aperture fields of a periodic array of rectangular apertures in a conducting screen. This problem is a three-dimensional vector diffraction problem for which the only previous solutions have been approximations valid in the long wavelength limit. The solution obtained is valid over the aperture resonance region, which is clearly indicated from calculations of the transmission coefficient. The effects of coupling to neighboring apertures are taken into account implicitly in the formulation through the use of a periodic Green's function. The aperture field distribution is obtained by approximate solution of an integral equation.

The second approach involves evaluation of the scattered fields by a generalized variational method. This method enables calculation of scattering coefficients of spurious diffraction lobes, so that the directional distribution of the scattered energy can be evaluated. Previous variational methods applied to diffraction problems have only allowed evaluation of the total scattered energy, and not of its angular distribution.

Using the variational method, the transmission and scattering coefficients of a screen containing a doubly periodic array of square apertures are evaluated over a range of wavelength to aperture spacing ratio in which several spurious diffraction lobes propagate. The resonance phenomenon arising due to the periodicity is also investigated. The admittance of a resonant square aperture in square waveguide propagating the TE_{11} mode is calculated and compared with experiment.

Microfilm $2.75; Xerox $9.45. 207 pages.

PHYSICS, NUCLEAR

THE NEUTRAL DECAY MODE OF THE LAMBDA HYPERON AS OBSERVED IN A XENON BUBBLE CHAMBER

(L. C. Card No. Mic 61-1725)

Howard Carnes Bryant, Ph.D.
University of Michigan, 1961

The decay of the lambda hyperon into a neutral pion and a neutron has long been suspected and indeed has been indirectly observed electronically and in a bubble chamber. For about half of such neutral decays that occur in a xenon bubble chamber both gamma rays from the decay of the neutral pion convert into electron-positron pairs. This high conversion probability makes possible a rather clear-cut identification of such events.

In an exposure of the University of Michigan xenon bubble chamber to a beam of negative pions of about one billion electron volts kinetic energy, thirty-five events of the above described type were found in association with charged decays of the neutral theta meson in pictures of high visibility. On the basis of these events and ninety-six events of the charged-pionic decay mode of the lambda, with the same conditions as were applied to the neutral events, the rate of neutral decay to all pionic decays for the lambda hyperon is 0.35 ± 0.05. The ratio of the neutral mode asymmetry parameter to the charged mode asymmetry parameter is found to be 1.2 ± 1.0, and the mass (in terms of its energy equivalent) of the neutral pion from the lambda decay is found to be 126 ± 6 million electron volts. Microfilm $2.75; Xerox $5.00. 96 pages.

SCATTERING OF HIGH ENERGY NUCLEONS BY DEFORMED NUCLEI

(L. C. Card No. Mic 61-273)

Emmett Gary Corman, Ph.D.
University of Kansas, 1960

Atomic nuclei which lie in certain mass ranges possess deformations from sphericity. The primary purpose of this work is to investigate the effects of the target nuclear deformations upon the high energy (~ 100 – 200 Mev) differential elastic and rotational cross sections for nucleon-nuclear scattering. The "optical model" is applied for such processes; the detailed nuclear structure is replaced by an equivalent ellipsoidal shaped complex potential region.

One approach used to obtain the scattering amplitude is that of a partial wave analysis, using a square well potential with an ellipsoidal boundary for the target nucleus. For a neutron-nuclear system the Schrödinger equation in ellipsoidal coordinates can be separated in the region inside and the region outside the nuclear boundary. The three resulting total differential equations can be solved exactly. By writing the total wave function in its asymptotic form as a sum of an incoming plane wave and an outgoing spherical wave, i.e., $\psi_r \underset{r \to \infty}{\rightarrow} e^{i\vec{k}\cdot\vec{r}} + \frac{e^{ikr}}{r} f$,

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

the scattering amplitude f was obtained in terms of the phase shifts $\delta_{\ell m}$. The latter were solved by equating the logarithmic derivatives of the total wave functions at the ellipsoidal boundary and ignoring all powers of $\frac{V}{E}$ greater than one, where V is the potential depth and E the neutron energy. The differential cross section was obtained by multiplying f by its complex conjugate, and it was averaged over all possible orientations of the target nucleus.

A greatly improved approach to the problem involves using the high energy approximation integral for the small angle scattering amplitude derived by Schiff and Glauber. It was used throughout the remaining portion of the work and with a deformed potential which is of the following analytical form in a space of spherical symmetry:

$$V(r) = -(V_o + iW_o)\left(1 - \frac{r^2}{R^2}\right)^{1/2}, \quad r < R; \quad V(r) = 0, \quad r > R .$$

Letting the scattering plane coincide with the x - z plane, the differential cross section was solved for three different nuclei (Al^{27}, Eu^{153}, and Lu^{176}) each in three different orientations, i.e., with the nuclear symmetry axis along each of the three coordinate axes. The cross section vs. scattering angle was plotted for the three orientations. The curves were found to differ appreciably, especially in the vicinity of the first minimum. The minimum is displaced somewhat as the orientation is varied. The differential cross section averaged over the three orientations was compared with that for the spherical nucleus of nuclear volume and potential depths equal to those for the deformed nucleus. The curves very nearly coincide except in the vicinity of the minimum where the spherical curve is somewhat deeper.

The differential cross section for a nucleus of arbitrary orientation was also calculated by transforming space coordinates in the scattering amplitude integral in such a way that the ellipsoid became a sphere. The average over orientations was then easily obtained by integrating over orientation angles. Results were plotted for the three nuclei as before and comparisons were made with the corresponding spherical nuclei. The cross sections obtained by this continuous averaging were found to be very nearly equal to those obtained by averaging over the three discrete orientations.

Differential cross sections for neutron scattering with the simultaneous excitation of the target nucleus to arbitrary rotational levels were also calculated for Al^{27} and Lu^{176}. The scattering amplitude then becomes the integral $\int \phi^*_{ni}(\omega) f(\omega,\Omega) \phi_{no}(\omega) d\omega$, where ω and Ω are the orientation and scattering angles, and ϕ_{no} and ϕ_{ni} are the nuclear rotational wave functions for the initial and final states. The "summed cross section," which is the cross section summation over all possible final rotational states, was found to be $\frac{1}{4\pi} \int |f(\omega,\Omega)|^2 \, d\omega$ for an arbitrary initial state. For obtaining numerical results for the excitation cross section, an initial spin-zero state was assumed. The cross section is then $\frac{1}{4\pi} \left| \int Y_{IM}(\omega) f(\omega,\Omega) d\omega \right|^2$, where $Y_{IM}(\omega)$ is the normalized spherical harmonic for the final state of total spin I and azimuthal spin M.

In order that theoretical deductions may include polarization effects in nucleon-nuclear scattering, the central nuclear potential was modified by an additive term which depends upon the spin-orbit interactions, i.e., $V_{so}(r) \frac{\vec{\sigma} \cdot \vec{L}}{\hbar}$. The differential cross section and polarization were then calculated and averaged over orientations. For an arbitrary orientation the polarization $\vec{P}$ generally has a component in the scattering plane. However, upon averaging over ω, this component vanishes.

A method of calculating the scattering amplitude for proton-nuclear scattering was also investigated by using a uniform charge distribution inside and a screened Coulomb potential outside the ellipsoid.

Microfilm $2.75; Xerox $5.20. 104 pages.

INTERNAL BREMSSTRAHLUNG FROM P^{32} AND Y^{90}

(L. C. Card No. Mic 60-5911)

Mohamed Abdul Hakeem, Ph.D.
Louisiana State University, 1960

Supervisor: Professor Max Goodrich

The internal bremsstrahlung spectra of the allowed beta emitter P^{32} and the first forbidden beta emitter Y^{90} have been studied with a scintillation spectrometer using a cylindrical 3 inch X 3 inch NaI(Tl) crystal. The observed spectra have been compared with the available theoretical calculations.

In the case of P^{32} it was found that the experimental spectrum does not agree exactly with Knipp, Uhlenbeck and Bloch theory for allowed beta transitions. The deviations are not very large but they are significant. They can be explained very well with the Coulomb corrected theory of Lewis and Ford. Hence, it is concluded that first order Coulomb correction is sufficient to explain P^{32} (Z = 15) results and that the contribution from nuclear radiation arising from the detour transitions is negligible.

The observed Y^{90} spectrum was found to be in considerable disagreement with Chang and Falkoff extension of Knipp, Uhlenbeck and Bloch theory for first forbidden beta transition with tensor interaction ($\Delta 1 = 2$, yes). The Coulomb correction proposed by Lewis and Ford which was successful in the case of P^{32} is not sufficient to account for the deviation. Lewis and Ford have calculated the photon contribution from detour transitions for Y^{90}. These calculations explain reasonably the disagreement between theory and experiment. Without investigating theoretically the effect of vector and axial vector interaction on the spectrum in forbidden transitions, it is difficult to draw any definite conclusions about the contribution from detour transitions; since the recent evidence seems to favor vector and axial vector interactions for beta decay theory rather than the tensor interaction.

Microfilm $2.75; Xerox $3.00. 46 pages.

PART I. TIME DEPENDENCE OF MÖSSBAUER TRANSMISSION. PART II. SIGN OF THE NUCLEAR QUADRUPOLE INTERACTION FROM POLARIZED GAMMA-GAMMA ANGULAR CORRELATIONS.

(L. C. Card No. Mic 61-1619)

Samuel Melvin Harris, Ph.D.
University of Illinois, 1961

PART I.

The time dependent Mössbauer transmission has been calculated for the case of extremely thin and of thick absorbers. The system considered consists of nuclei which decay via a two photon cascade. The second photon is taken to be emitted without recoil so that it is subject to resonant absorption by the absorber nuclei (Mössbauer effect), whose resonance may be shifted due to a small relative velocity between source and absorber. The transmission is obtained when the transmitted recoilless photon is measured in coincidence with the first photon of the cascade. The problem is attacked by writing down the coupled quantum mechanical equations for the source and absorber nuclei. The result is in agreement with that obtained by considering the absorber as a classical dielectric slab capable of absorption and dispersion.

The initial conditions have been investigated in detail by considering the full cascade. In this manner, one sees that the usual simple assumption, that the nucleus is in the first excited state immediately after the emission of the first photon, gives the correct boundary condition. Likewise, a more exact treatment of the Doppler shift verifies the simple treatment in which the absorber nuclei are assumed to have a slightly different resonant frequency from that of the source nuclei. Correction terms which arise from this detailed treatment are of the order of v/c and, therefore, not measurable experimentally.

PART II.

The sign of the nuclear quadrupole interaction cannot be determined by the measurement of unpolarized $\gamma-\gamma$ angular correlations. It can, however, be found by in addition measuring the circular polarization of one of the radiations. The general polarized correlation function is derived here, when the intermediate state of a $\gamma-\gamma$ cascade is subject to a nuclear quadrupole interaction with an axially symmetric electric field gradient. In particular appropriate formulae are given to enable the reader to calculate easily the correlation function as a function of crystal orientation when the two radiations are emitted in directions making angles of 90° and 180° with each other, are of multipole order $L \leq 2$, and involve an intermediate state with spin $I \leq 7/2$. It is assumed that the polarization of only the first radiation is detected. For the case of 90° relative emission, terms enter which depend on the sign of the interaction. The application of this technique to $\beta-\gamma$ correlations, where no polarization measurement is made, is discussed. Particle parameters are given which permit the calculation of the $\beta-\gamma$ correlation for allowed beta transitions. Only the Gamow-Teller part of the transition yields a nonisotropic contribution to the correlation function. The sign of the quadrupole interaction again enters into this result due to the electron polarization in beta decay which arises because of parity nonconservation in weak interactions.

Microfilm $2.75; Xerox $5.20. 103 pages.

A STUDY OF K_1° MESON DECAYS IN THE XENON BUBBLE CHAMBER

(L. C. Card No. Mic 61-1821)

Richard Walter Hartung, Ph.D.
University of Michigan, 1961

Previous studies of K_1° decays have indicated that about 1/3 of the decays are into neutral particles, but have given relatively little direct information on such neutral decays. The present experiment was done in a xenon bubble chamber; the high efficiency of liquid xenon for the conversion of gamma rays into electron pairs made it possible to observe the neutral decays directly.

The K_1° were produced in the chamber by 1.1 Gev π^- mesons. Only events with a "K° signature" in the form of a Λ° decay which satisfied a set of strict requirements were used. Out of a total of 175 such Λ° events, 53 had an associated V track which was consistent with being from the decay $K_1^\circ \rightarrow \pi^+ + \pi^-$, and 28 had sets of two, three, or four gamma ray pairs which appeared to come from a common point in the chamber and were consistent with being from a neutral decay of the form $K_1^\circ \rightarrow 2\pi^\circ$, followed by $\pi^\circ \rightarrow 2\gamma$. (Other decays, such as $K_1^\circ \rightarrow 4\gamma$ cannot be ruled out.)

With the above interpretation and corrections for escape of K_1° or γ rays, the branching ratio, $B^n(K_1^\circ)$, can be directly determined:

$$B^n(K_1^\circ) = \frac{K_1^\circ \rightarrow 2\pi^\circ}{\text{all } K_1^\circ} = .35 \pm .05$$

This value is consistent with the prediction of .338 on the $|\vec{\Delta I}| = 1/2$ hypothesis.

Microfilm $2.75; Xerox $4.00. 72 pages.

THE STRUCTURE OF REPRESENTATIONS OF THE CANONICAL COMMUTATION RELATIONS [with] APPENDICES

(L. C. Card No. Mic 60-5018)

John S. Lew, Ph.D.
Princeton University, 1960

A given heuristic representation of a quantum field and its conjugate momentum on a spacelike hyperplane is reformulated, first in terms of the "smeared" field operators $\phi(f)$ and their momenta $\pi(g)$, then in terms of the unitary operators $U(f) = e^{i\phi(f)}$ and $V(g) = e^{i\pi(g)}$. The arguments f and g are generalized to elements of abstract real vector spaces $\mathcal{V}_\phi$ and $\mathcal{V}_\pi$ respectively, paired by a non-singular bilinear form. We assume the canonical commutation relations as equations in U(f) and V(g), and study the structure of this system.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

An operator calculus is developed for bounded Borel functions of finite numbers of field operators $\phi(f)$, and is expressed in a basis-independent form on the duals of finite-dimensional subspaces of $\mathcal{V}_\phi$. In these dual spaces the operators V(g) are found to act as translations. The class of tame operators, functions of the $\phi(f)$, is introduced and used to generate a commutative C^*-algebra $\overline{\mathcal{A}}$, whose structure is independent of representation. We invoke the results of Gelfand to express the operators in $\overline{\mathcal{A}}$ as continuous functions on the spectrum of $\overline{\mathcal{A}}$, and thus in effect to diagonalize the fields $\phi(f)$. The spectrum $\tilde{Z}$ is shown to be in one-to-one correspondence with the set $\tilde{Z}$ of all generalized linear functionals on $\mathcal{V}_\phi$, a set containing the algebraic dual space $\tilde{Z}_o$.

We discuss the topology and measure theory of $\tilde{Z}$, noting different ways to describe them. When a basic measure exists on $\tilde{Z}$, for which we give conditions, all operators in $\overline{\mathcal{A}}''$ are expressible as bounded Borel functions on $\tilde{Z}$. All measures induced by representations of U(f) and V(g) are proper measures, for which $\tilde{Z}_o$ can be shown a Baire thick subset of $\tilde{Z}$. Thus all operators in $\overline{\mathcal{A}}''$ are expressible as bounded Baire functions on $\tilde{Z}_o$.

We compare possible continuity conditions on U(f) and V(g), and introduce the symmetry group $\mathcal{G}$ with its unitary representation V(T). Given sufficiently strong continuity of U(f), V(g), and V(T), a representation of these operators in a non-separable Hilbert space reduces to a direct sum of representations in separable Hilbert spaces. Using theorems on von Neumann algebras, we write $\overline{\mathcal{A}}'$ as a direct integral on $\tilde{Z}$ for any representation in a separable Hilbert space, or, more generally, for any countable representation. By an extension of earlier arguments, this direct integral can also be expressed on $\tilde{Z}_o$.

Noting that V(g) and V(T) induce automorphisms of $\overline{\mathcal{A}}$, $\overline{\mathcal{A}}'$, and $\overline{\mathcal{A}}''$, we use the properties of such automorphisms to represent V(g) and V(T) in the direct integral formalism. This yields a Schrödinger-like description of the given representation, in which the U(f) are expressed as multiplication operators, the V(g) as (normalized) translations, and the V(T) as transformations induced by one-to-one maps on $\tilde{Z}$. We give criteria for Euclidean invariance, unitary equivalence, and irreducibility of a representation. A complete set of invariants consists of the dimension (almost everywhere) of the field of Hilbert spaces integrated over $\tilde{Z}$, and equivalence classes of the basic measure given on $\tilde{Z}$ and of the unitary transformations V(z - g, z) and V(T*z, z) obtained in describing V(g) and V(T). All this structure can be expressed on $\tilde{Z}_o$.

We outline in Appendices I-VII the mathematical tools used in this enterprise, and present in Appendices VIII-IX a theory of measurable functions used in the reduction to $\tilde{Z}_o$. In Appendices X-XII we compute the spectra of several algebras other than $\overline{\mathcal{A}}$, to show the peculiarities which arise, and thus the advantages of $\overline{\mathcal{A}}$.

Microfilm $5.90; Xerox $12.95. 463 pages.

L SHELL FINE STRUCTURE IN HEAVY ATOMS

(L. C. Card No. Mic 61-1429)

Charles William Lindenmeier, Ph.D.
Cornell University, 1960

Since precision X-ray measurements are available for the $2p_{1/2}$ - $2p_{3/2}$ energy difference in heavy atoms, improved accuracy in the theoretical contributions can yield (on comparison with experiment) information on Lamb shift effects which are neither directly observable nor easily calculated. In the present effort relativistic theory is used throughout, and consequently the closeness of agreement between theory and experiment is also an indication of the validity of Dirac theory for large (αZ).

It is shown that inaccuracies in first order perturbation theory are so large as to obscure the Lamb shift effects, and it is necessary to perform a Hartree-Dirac calculation. Such a calculation has been carried out in a joint effort, and the results so obtained have sufficient accuracy for our purposes. Since the Lamb shift is of the same order of magnitude as the shift due to a finite nuclear charge distribution, this effect has also been calculated using the charge distribution found from the Stanford experiments. The currently available vacuum polarization results are improved in accuracy by using the normalization of the Hartree wave functions.

The major remaining portion of the Lamb shift corresponds to that term which for a nearly free electron comes from the anomalous moment. We therefore express the final differences between theory and experiment as being due to the electron's having an anomalous moment of the form $g_{eff} = (1 - \beta Z^n)(\alpha/2\pi)$. In addition, two different forms of a correction term to the Hartree theory of relative order Z^{-2} have been considered. Least squares fits yield a series of curves for the anomalous moment depending on the assumed form of the Hartree correction and the power of Z in the anomalous moment term. The curves have in common nearly the same variation, but one cannot accurately determine an absolute magnitude. From the "goodness" of the least squares fits, one concludes $g_{eff}(94) - g_{eff}(74) = -(.45 \pm .1)(\alpha/2\pi)$ and $g_{eff}(74) = (.5 \pm .3)(\alpha/2\pi)$.

Microfilm $2.75; Xerox $6.00. 125 pages.

SHELL MODEL STUDY OF THE Li^6 NUCLEUS WITH THE GAMMEL AND THALER TWO NUCLEON POTENTIAL

(L. C. Card No. Mic 61-2050)

Natalia Meshkov, Ph.D.
University of Pennsylvania, 1961

Supervisor: C. W. Ufford

An intermediate coupling shell model calculation has been carried out on the energy spectrum of the Li^6 nucleus using the Gammel and Thaler potential for the two nucleon interactions. The effect of the repulsive core has been calculated using Moshinsky's perturbation method. A comparison of the calculated and the experimental levels of Li^6 shows that the energies arising from the singlet even

and triplet odd G-T potentials are in agreement with the experiment, while a large discrepancy with the experiment arises from the triplet even central G-T potential.

In view of the uncertainty in the G-T triplet even potential parameters, a modification of these parameters is proposed such that a fit to the Li^6 spectrum is obtained, leaving all the other G-T potential parameters unchanged.

In addition, the quadrupole moment of Li^6 calculated with the modified G-T potential is in agreement with the experimental value. Our modified potential is quite similar to the effective potentials of other shell model studies. The spin orbit force in a nucleus, which is necessary to explain a large number of nuclear properties, is found to arise from the triplet odd G-T spin orbit potential in our work. Microfilm $2.75; Xerox $7.00. 146 pages.

A SHELL MODEL ANALYSIS OF CALCIUM ISOTOPES

(L. C. Card No. Mic 60-5025)

Henri Emmanuel Mitler, Ph.D.
Princeton University, 1960

Previous theoretical analyses of the structure of the calcium isotopes are reviewed and critically discussed, and the experimental data on their level structure is also presented.

An effective two-body internucleon potential, acting among the neutrons outside the calcium 40 core, is phenomenologically obtained, by fitting the known energy levels of Ca 42 and Ca 43. The fit to eight levels is only fair, the rms deviation being 124 kev. The potential is compared to that expected from nucleon-nucleon scattering experiments, and found to differ strongly from the latter: it is long-ranged, has a weak repulsive triplet (odd) and a strong, attractive tensor part. The reaction matrix, on the other hand, is short-ranged, has a weak attractive triplet, and a weakly repulsive tensor part. The fit is nevertheless better than what has been obtained heretofore.

A comparison of the calculated electromagnetic transition probabilities indicates a considerable amount of surface-particle coupling, indicating a strong admixture of one of the core states.

A theorem is derived which facilitates computation of tensor force matrix elements in j-j coupling.

Microfilm $3.45; Xerox $12.15. 268 pages.

SLOW-NEUTRON DIFFRACTION IN NORMAL LIQUIDS

(L. C. Card No. Mic 60-6907)

Arnulfo Morales Amado, Ph.D.
University of Michigan, 1960

In this work the Lennard-Jones and Devonshire liquid model potential function has been introduced into the low-energy neutron scattering formalism in order to calculate the differential cross-section (in angle and energy) for normal liquids. It can be shown that this Lennard-Jones and Devonshire potential approximates a parabola for values $(2\nu/\mu)^{1/2}\ a^{-3} \gtrsim .67$, where "a" is the distance between the centers of the cells and μ and ν can be obtained from the Lennard-Jones potential $(-\mu r^{-6} + \nu r^{-12})$ and gas-phase data. The model is characterized by the Hamiltonian $H = p^2/2M + M\omega^2 r^2/2$ where $\omega(\mu,\nu)$ is the oscillator frequency and M is the mass of an atom in the liquid.

Gas-phase data and formulas, appropriate to the model, derived in thermodynamics have been used in order to obtain the parameters that enter into the calculation of the angular cross-sections for Ne, Ar, Kr, Xe, N_2 and Pb. These cross-sections were compared to experimental data when available. The neutron final energy spectra at 90° scattering angle were computed at two temperatures (609°K and 823°K) for liquid Lead. The results were compared with experimental data and with the diffusion model theory.

The results obtained for the angular cross-sections are in satisfactory agreement with experimental data. The half-height widths of the calculated final neutron spectra for liquid Lead agree very well with experiment and are in better agreement than those calculated using the diffusion model. It is felt, however, that more experiments on the broadening of the energy spectrum should be performed, using monatomic elements as well as polyatomic elements, in order to further test the accuracy of the model introduced in this dissertation. No experiments on the energy distribution of normal polyatomic liquids have been reported in the literature.

Microfilm $2.75; Xerox $5.80. 120 pages.

SEARCH FOR DELAYED NEUTRONS FROM NUCLEAR INTERACTIONS DUE TO COSMIC RAYS

(Publication No. 18,033)

Irving Nadelhaft, Ph.D.
Syracuse University, 1956

The delayed neutron process, which consists of a beta decay followed by the emission of a neutron, has been predicted theoretically by Bohr and Wheeler, and observed by physicists operating nuclear reactors. In these cases the compound nucleus is obtained through slow neutron absorption, and the parent to the beta-neutron process is a fission fragment which has resulted from the decay of this compound nuclide. It was thought feasible to see if the delayed neutron process could also be observed in nuclear interactions initially caused by cosmic rays. In this case the delayed neutron need not be born of a fission fragment, but could come from some excited nuclide created by any of numerous paths depending upon the details of the interaction.

The initial interaction takes place within a sodium-iodide crystal scintillator which acts as both the producing material and detector. The crystal is surrounded by a neutron detector consisting of a liquid scintillator. Calibration procedures insure that both scintillators operate within the desired energy ranges. An event is constituted by a pulse in the crystal and the first subsequent pulse in

the liquid, and a distribution of the difference in time of these two pulses is obtained by the apparatus. Each time difference is punched automatically on an IBM card by a machine which is incorporated into the apparatus. The cards belonging to any one run can then be analysed quickly and efficiently by other IBM business machines.

The theory indicates that the distribution should be of the form:

$$p(t) = (b + \lambda n_o) \exp - (b + \lambda n_o)t$$

where b is the background rate in the liquid scintillator

n_o is the effective number of radioactive nuclei produced per interaction

t is the difference in time between the two pulses

and λ is the mean lifetime of the nuclei.

An examination of the results seems to indicate that there is little or no delayed neutron activity observed. However, it is possible to place an upper limit on the more important parameters describing the process. They are, $\lambda n_o < 0.00X$, and if one assumes a λ about equal to 0.1 millisecond^{-1}, $n_o < 0.0X$.

Microfilm $2.75; Xerox $3.60. 65 pages. Mic 60-3057.

THE LEVEL STRUCTURE OF Eu^{153} AND Eu^{155}

(L. C. Card No. Mic 61-1798)

Raymond Earl Sund, Ph.D.
University of Michigan, 1961

One of the main purposes of low-energy nuclear physics is to study the properties of nuclear energy levels and transitions and to relate these properties to nuclear models. The present investigation is concerned with the nuclear energy levels in Eu^{153} and Eu^{155}. The transitions connecting the energy levels were studied by observation of gamma-ray spectra and by means of internal conversion, coincidence, and directional correlation measurements. The results are interpreted in terms of collective motions and intrinsic excitations in deformed nuclei.

The gamma rays following the decay of Sm^{153} and Gd^{153} were studied in order to establish the level structure of Eu^{153}. Measurements were made of spectra of gamma rays in coincidence with the x-ray, 70-kev, and the 97-kev and 103-kev transitions in the decay of Gd^{153} and with eight energy regions in the decay of Sm^{153}. Measurements on the Sm^{153} decay showed that the 610-kev transition is in coincidence with the 97-kev gamma ray and that the 535-kev transition is in coincidence with the 103-kev gamma ray. In addition, new, weak transitions of 67 kev, 154 kev, 352 kev, 422 kev, 458 kev, and 525 kev were observed in the decay of Sm^{153}. Energy levels at 458 kev, 525 kev, 595 kev, 638 kev, 679 kev, and 707 kev in Eu^{153} are proposed. Directional correlation measurements were made on the 70-kev — 103-kev cascade from the decay of Sm^{153} and from the decay of Gd^{153}. The directional correlation results and other experimental data show that the spins and parities of the 173-kev, 103-kev, and ground state levels are 5/2+, 3/2+, and 5/2+ respectively. The states are discussed in terms of intrinsic and collective excitations.

Sm^{155} was found to decay to Eu^{155} with a half-life of 21.9 ± 0.2 minutes. Twelve internal conversion electron lines corresponding to nine gamma ray transitions in Eu^{155} were observed in magnetic spectrograph measurements. The gamma ray spectrum was studied with a well crystal. A peak at 288 kev from the x-ray summing with the 246-kev gamma ray was observed. Measurements were made of gamma rays in coincidence with the x-ray, 104-kev, 142-kev, and 246-kev transitions. New, weak gamma-rays of 68 kev and 103 kev were observed, and energy levels at 314 kev and 349 kev in Eu^{155} are proposed. Directional correlation measurements were made on the 142-kev — 104-kev cascade. Possible spin assignments are discussed. The levels are interpreted in terms of intrinsic excitations of deformed nuclei.

Microfilm $2.75; Xerox $5.20. 103 pages.

INVESTIGATIONS OF THE $Al^{27}(p,\gamma)Si^{28}$ REACTION

(L. C. Card No. Mic 61-1937)

John Ignatius Valerio, Ph.D.
State University of Iowa, 1961

Chairman: Professor Edward B. Nelson

The $Al^{27}(p,\gamma)Si^{28}$ reaction at the 226, 294, 326, 405, and 630 kev resonances was investigated with the S.U.I. accelerators. Gamma ray spectra have been studied with a large 5" x 6" NaI(Tl) crystal scintillation detector. At the 326 and 405 kev resonances spectra were also taken with a high resolution three crystal pair spectrometer, which permitted accurate energy identification. Coincidence studies of the radiation served to resolve the complex cascade decay of the capture states.

Double correlations (p,γ), (p, X, γ), and (p, X, X, γ), and triple correlations (p, γ, γ), (p, X, γ, γ), and (p, γ, X, γ) at the 326, 405, and 630 kev resonances have established the spin sequences involved in the main double and triple cascades observed. The symbol "X" denotes an unobserved intermediate radiation. Spins and parities of various levels in Si^{28} have been determined.

Low lying levels: 1.78 Mev, $J^\pi = 2^+$
4.62 Mev, $J^\pi = 4^+$

Intermediate energy levels: 8.59 Mev, $J^\pi = 3^+$
9.38 Mev, $J^\pi = (3^+)$

Capture state levels: 11.87 Mev, $J^\pi = (4^-)$;
11.90 Mev, $J^\pi = 4^-$;
11.98 Mev, $J^\pi = 4^-$;
12.20 Mev, $J^\pi = 3^-$.

Assigned spin values placed in parentheses are not based upon the results of correlation measurements.

Microfilm $2.75; Xerox $7.20. 154 pages.

CORRECTIONS TO THE PERTURBATIVE TWO-PION-EXCHANGE NUCLEAR POTENTIAL

(L. C. Card No. Mic 61-2074)

Malcolm Cecil Younger, Ph.D.
University of Pennsylvania, 1961

The purpose of this thesis is to investigate the reliability of the static limit for evaluating the two-pion-exchange internucleon potential. The determination of the corrections to the static limit is based on the definition of the potential in terms of the scattering matrix, as given by Klein and McCormick. Therefore, the static limit under consideration is the potential of Brueckner and Watson.

The usual expansion of the potential, in powers of the ratio of the virtual pion momentum to nucleon mass, therefore, is not made. Instead, expansions are made only in powers of pM^{-1}, where M is the nucleon mass and p is the relative momentum of the two nucleons. In the final numerical evaluation of the potential, an expansion in pion momentum is made. However, this is done only after the form of the integrals has been changed in such a manner that the contribution from large pion momenta is negligibly small.

In most states, the corrections are of the order of 10% – 20% for an internucleon separation of one pion Compton wavelength. This is to be expected, since μM^{-1} is approximately 0.15. In the singlet even state, for example, the corrections are repulsive, and therefore have the correct sign for bringing the predictions of this potential into conformity with experimental results. In general, the results suffice to show that the static potential, although qualitatively correct, is quantitatively wrong. Furthermore, a spin-orbit potential is obtained automatically in this calculation, although it has not been evaluated numerically.

Microfilm $2.75; Xerox $5.20. 105 pages.

PHYSICS, SOLID STATE

THE EFFECT OF PRESSURE ON ZINCBLENDE AND RELATED STRUCTURES

(L. C. Card No. Mic 61-1607)

Arthur Lindley Edwards, Ph.D.
University of Illinois, 1961

The effect of pressure on the optical absorption edge has been measured for a number of compounds having the zincblende and related structures, from one atmosphere up to maximum pressures from 35 to 170 kilobars. Included in the study are the group III-V compounds AlSb, GaSb, InP, and InAs, the group II-VI compounds CdS, CdSe, and CdTe, and the group I-VII compounds CuCl, CuBr, and CuI. A qualitative interpretation of the results for the group III-V and group II-VI compounds can be made consistent with the known structure and pressure shifts of the electronic energy bands in Si and Ge, and the available experimental and theoretical evidence concerning the band structures of these and similar compounds. Results for the group I-VII compounds would appear to require some modification of the energy band picture used for the other groups, presumable due to the strong ionic character of the bonding in this group.

Polymorphic transitions induced by pressure have been observed in CdS, CdSe, CdTe, CuCl, CuBr, and CuI. Those in CuCl and CuBr have been studied at combined high pressure and high temperature in the range from 0-160 kilobars and 25-500°C, the results indicating that the high pressure forms might be stable at atmospheric pressure at sufficiently low temperatures.

A broad absorption band on the low energy side of the absorption edges of GaSb and InP was observed at higher pressures. In each case, the band grows irreversibly with increasing pressure. In the cases of CdS, CdSe, and CdTe, the whole absorption edge appears to shift red irreversibly upon the initial application of pressure up to 10 kilobars, from 0.05 to 0.10 ev. Investigations to determine the cause of these effects were inconclusive.

A small, sharp peak on the absorption edge of CuCl, probably due to a d^{10} to d^9s transition in the Cu ion, was observed up to 50 kilobars. The peak appears to be a doublet or triplet, and with increasing pressure, shifts slightly blue and becomes less intense.

Microfilm $2.75; Xerox $6.80. 144 pages.

SURFACE STUDIES IN ULTRAHIGH VACUUM BY RADIOTRACER TECHNIQUES

(L. C. Card No. Mic 61-1614)

Eberhard Goeler von Ravensburg, Ph.D.
University of Illinois, 1961

The usefulness of radiotracer techniques for studies of interactions between clean surfaces and single atoms is examined. It is found that the conventional evaporation methods employed in depositing the tracer onto a surface usually introduce large amounts of contaminants. It is known that an atom undergoing a nuclear decay while adsorbed to a surface may in special cases be supplied a recoil energy sufficient to overcome the surface binding forces. A beam of atoms can be formed in this way. For subsequent detection of the beam a second decay is needed.

The method is used to determine the interactions of silver with heat-cleaned surfaces of molybdenum and nickel. The desorption probabilities are measured in the temperature range 300°K to 1400°K. They are found to obey relations of the type $w = w_o \exp(-E/kT)$. For the molybdenum surface $E = 2.2 \pm .2$ ev and $.2 \times 10^{10}$ sec^{-1} $< w_o <$ 40×10^{10} sec^{-1}, and for the nickel surface $E = 1.55 \pm .25$ ev and $.03 \times 10^8$ sec$^{-1} < w_o <$ 50×10^8 sec^{-1}. In addition, it is deduced that the sticking coefficient of Ag on both surfaces is independent of the substrate temperature. The energy of the silver atoms is approximately 8 ev. The pressure in the apparatus is less than 10^{-9} mm of Hg. Microfilm $2.75; Xerox $4.20. 79 pages.

FREQUENCY DEPENDENT HALL EFFECT IN NORMAL AND SUPERCONDUCTING METALS

(L. C. Card No. Mic 61-1646)

Peter Benjamin Miller, Ph.D.
University of Illinois, 1961

This paper discusses the Hall current flow occurring in a normal and a superconducting metal when both a static magnetic field (H_0) and an electromagnetic wave are applied on the metal, with the electric field of the wave being perpendicular to H_0. The entire frequency range of the electromagnetic wave from audio to optical is discussed although the main emphasis is on the microwave region.

The first Section gives an introduction to the frequency dependent Hall effect in various solids including semiconductors, ferromagnetics, normal metals and superconductors. The close connection between Hall current flow and Kerr (magneto) rotation as well as Faraday rotation is discussed for the entire range of the electromagnetic frequency spectrum. A simple formula for the Kerr rotation in normal metals at optical frequencies is derived and shown to be in approximate agreement with the experiment of Majorana.

In Section II we derive a relation for the non local, transverse Hall current in the normal metal by solving the Boltzmann equation. In Section III we give a detailed analysis of the microwave Kerr rotation in a circular cylindrical cavity with the normal metal forming the end plate of the cavity. The result for the Kerr rotation in the cavity shows that this experiment provides a good test for the validity of the non local Hall current in normal metals.

In Section IV we give a qualitative discussion of the relation between a longitudinal and a transverse Hall current in a superconductor. As usual longitudinal means that the current has a non zero divergence whereas transverse implies a zero divergence. We then give a detailed microscopic theory of the transverse Hall current in a superconductor based on the Bardeen-Cooper-Schrieffer model of the superconductor and including the effect of collective excitations by means of the generalized random phase approximation given by Anderson and by Rickayzen. We show explicitly that the collective coordinates are zero if the interaction potential $V(\vec{k},\vec{k}')$ is independent of angle and with an appropriate choice of gauge. We assume H_0 is constant throughout the sample as would be appropriate for a very thin film. The final result for the Hall current is expressed in Q space. For small Q we get the simple result

$$j_{HALL}(Q) = -\frac{R_0\sigma_0^2 H_0}{(1+i\omega\tau)^2}\frac{\rho_n}{\rho}E(Q) \quad , \qquad (1)$$

where in the microscopic theory ρ_n/ρ corresponds to the fraction of normal electrons of a two fluid model. The theoretical result (1) is in qualitative agreement with a two fluid model which assumes that the primary normal component of current is proportional to ρ_n/ρ and that only the normal component and not the supercurrent is acted on by the magnetic field. We also show that the result (1) is in qualitative accord with the null result of Lewis for the Hall E.M.F. in a superconductor at audio frequencies. The application of the result for the Hall current to small superconducting specimens is also discussed. Microfilm $2.75; Xerox $3.80. 69 pages.

FERROMAGNETIC RESONANCE LINE WIDTH IN FERRITES

(L. C. Card No. Mic 61-2055)

Ernest Eugene Pittelli, Ph.D.
University of Pennsylvania, 1961

Supervisor: Herbert B. Callen

In disordered magnetic materials such as the ferrites the source of loss, and hence of resonance line width, may be attributed to processes involving only two elementary excitations; the destruction of a magnon with the creation either of another magnon or of a phonon. These processes are possible because of the lack of translational symmetry in the lattice, in contrast to an ordered structure, in which only multiple-excitation processes are permitted. Consequently, the loss in a disordered sample can, in principle, be relatively large.

Over a temperature range where the primary magnon-magnon scattering process dominates the observed loss we show that the random variation of the spin-orbit coupling parameters of the disordered ions in ferrites leads to a resonance line width comparable to those observed in the various ferrites. The particular symmetry of the crystalline fields around the octahedrally-coordinated sites causes an anisotropy in the line width with a minimum in the [100] directions and a maximum in the [111] directions. This anisotropy of line width is in excellent agreement with experimental observations on typical ferrites, as for example, the measurements of Schnitzler, Folen, and Rado on disordered lithium ferrite.
Microfilm $2.75; Xerox $5.60. 113 pages.

THE MEASUREMENT OF THE IONIC HALL EFFECT IN SODIUM CHLORIDE

(L. C. Card No. Mic 61-1775)

Philip Lloyd Read, Ph.D.
University of Michigan, 1961

High temperature ionic Hall effect measurements in large single crystals of pure sodium chloride were undertaken in order to: (a) demonstrate the existence of the ionic Hall effect, and (b) measure the temperature dependence of the Hall mobility of the ionic charge carriers.

The ionic Hall effect has previously never been observed in a solid although an upper limit for the effect in NaCl has been set. Also, only two ionic (drift) mobility measurements in NaCl exist, and neither measurement was carried out near the melting point. In Chapter I, the desirability of making independent ionic mobility measurements by a more straightforward method than previously used is discussed, and Hall effect measurements are proposed.

The usual mobility theory for ionic charge carriers is

described in Chapter II, and the previous mobility measurements in NaCl are summarized.

A theory of the Hall effect in ionic conductors is developed in Chapter III. The physical origin of the Hall effect is clearly exhibited. The usual mobility theory of ionic charge carriers is re-examined and a small correction made. The Hall effect theory proceeds directly from this corrected mobility theory and gives the relationship between the measured Hall voltage and the Hall mobility of the ionic charge carriers.

The major problem in the measurement of the Hall effect in ionic conductors is that the Hall voltage is extremely small and is superimposed on several other transverse voltages. The sensitive ac cross-modulation Hall effect apparatus used in our measurements is described in detail in Chapter IV. The precautions taken to insure against the production of spurious signals are also described.

The results of our ionic Hall effect measurements in NaCl are given in Chapter V. In spite of the presence of a large amount of current noise, measurements were made at seven temperatures in the range 601° -780 °C. The observed Hall voltage is proportional to the magnitude of the applied fields and has the expected temperature dependence. The Hall mobility calculated from this data is fitted by a curve which lies between extrapolations of the two previous drift mobility measurements. An estimate of the Hall mobility of the sodium ion vacancy in NaCl is made which gives an activation energy of 0.87 ± 0.10 ev and a pre-exponential coefficient of $2.0 + 8 - 1.5/T$ $(\text{meter})^2/\text{volt-second}$.

These results are shown to be in fairly good agreement with previous data, and the approximate equality of the Hall and drift mobilities of the ionic charge carriers in NaCl is demonstrated. These measurements represent the first observation of the ionic Hall effect and are within the previously set upper limits. Possible sources of spurious signals are discussed, and reasons for attributing the measured signals to the Hall effect are given. Possible sources of the current noise are also discussed. Abortive measurements on AgCl are described. Finally, suggestions for further measurements are presented.

Microfilm $2.75; Xerox $6.00. 125 pages.

ANISOTROPIC DIFFUSION OF SILVER AND INDIUM TRACERS IN SINGLE CRYSTALS OF ZINC

(L. C. Card No. Mic 61-1691)

Joseph Henry Rosolowski, Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: H. B. Huntington

The diffusion of the radiotracers silver (110) and indium (114) was measured by a sectioning technique in single crystals of 99.999% pure zinc in directions parallel and perpendicular to the hexagonal axis. The diffusion rate of both tracers was found to be highly anisotropic with a ratio of faster to slower diffusion rate close to two. The silver diffused at a rate about an order of magnitude slower than that of self-diffusion and $D_{\parallel} > D_{\perp}$. The indium diffused at a rate about an order of magnitude faster than that of self-diffusion and $D_{\perp} > D_{\parallel}$.

The results of the measurements are:

For silver (110)

$$D_{\parallel} = (0.32 \pm 0.02) \exp - \frac{(26.0 \pm 0.1) \times 10^3}{RT} \quad \text{cm}^2/\text{sec}$$

$$D_{\perp} = (0.45 \pm 0.07) \exp - \frac{(27.6 \pm 0.2) \times 10^3}{RT} \quad \text{cm}^2/\text{sec}$$

For indium (114)

$$D_{\parallel} = (0.062 \pm 0.008) \exp - \frac{(19.1 \pm 0.1) \times 10^3}{RT} \quad \text{cm}^2/\text{sec}$$

$$D_{\perp} = (0.14 \pm 0.02) \exp - \frac{(19.6 \pm 0.1) \times 10^3}{RT} \quad \text{cm}^2/\text{sec}$$

The results are interpreted to support a vacancy mechanism as being the principal mode of impurity migration in zinc. This interpretation is supported by the fact that the data may be reasonably fit by assuming a vacancy mechanism is operating. It is also supported by the fact that the magnitudes of the diffusion rates compared with that for self-diffusion are in qualitative agreement with the predictions of the Lazarus theory for the effect of a difference in valence between solute and matrix on the solute diffusion rate. This theory assumes a vacancy mechanism is operating.

Microfilm $2.75; Xerox $4.40. 81 pages.

THE THERMAL CONDUCTIVITY OF LEAD AT LOW TEMPERATURE

(L. C. Card No. Mic 61-1682)

Charles Lambert Wolff, Ph.D.
University of Illinois, 1961

Detailed low temperature thermal conductivity measurements on Pb samples with impurities < .05 atomic percent have been combined with Olsen's data on Pb-Bi alloys to display a relation between the strength of point defect scattering and K_s/K_n at constant temperature. As long as lattice conductivity is unimportant, K_s/K_n varies linearly with the square root of the ratio, r, of point defect scattering resistance to phonon scattering resistance in the normal state. This relation also holds for the Hg data of Hulm. The specimens studied had values of r ranging from .02 to 2.

An extrapolation to $r = 0$ of this linear relation provides curves which are interpreted as the temperature dependence of K_s/K_n in perfectly pure Pb and Hg. These curves do not agree with the theory of Kadanoff and Martin unless an unusually large value for the energy gap at absolute zero, ($7.3\ kT_c$), is assumed.

The thermal magneto-resistance of Pb has been measured in longitudinal field and compared with Mendelsolm and Rosenberg's results. The longitudinal and transverse resistance appear to approach each other above 4°K in Pb, while below this temperature their behaviors are radically different. An attempt to identify isotope scattering of phonons in the superconducting state proved inconclusive. Microfilm $2.75; Xerox $3.00. 59 pages.

THERMAL CONDUCTIVITY OF SILICON AT LOW TEMPERATURES

(L. C. Card No. Mic 61-1381)

Benny Alfred Younglove, Ph.D.
The University of Texas, 1961

Supervisor: Dr. J. C. Thompson

The thermal conductivity of silicon has been measured for four samples of single crystal silicon over the temperature range 2.5 of 200°K. Application of the phenomenological theory of Callaway fits the data for the sample of highest purity, (2000 ohm-cm) but will fit the data of the impure specimens only if an effective boundary scattering length is introduced that is much smaller than the length measured from the actual crystal dimension. Thus the data of the impure samples indicate the presence of a scattering mechanism active at temperatures where boundary scattering dominates in the case of a pure sample.

Microfilm $2.75; Xerox $3.00. 59 pages.

PHYSIOLOGY

ELECTRICAL AND CHEMICAL EVENTS ASSOCIATED WITH THE ACTION OF INSECTICIDES ON THE CENTRAL NERVOUS SYSTEM OF THE AMERICAN COCKROACH [PERIPLANETA AMERICANA (L.)].

(L. C. Card No. Mic 61-1599)

Brian Ellman Brown, Ph.D.
University of Illinois, 1961

It has been reported recently that injections of tetramethyl pyrophosphate (TMPP) into roaches (Periplaneta americana L.) prostrated by DDT were relatively ineffective in inhibiting the cholinesterase (CHE) of the roach central nervous system (CNS). In the early prostrate stage of DDT poisoning an injection of TMPP which normally inhibits 90% of the CHE causes only 10 to 20% inhibition. This phenomenon correlates with DDT symptoms, lower inhibitions resulting as symptoms advance to paralysis. In isolated or in situ cords of DDT-prostrate roaches, no CHE-protection was found; this occurred even when TMPP was applied in blood from DDT-prostrate roaches, which is known to contain a neuroactive factor released by the nervous system during DDT poisoning. With the use of two tracers, P^{32}-orthophosphate and sodium fluorescein, it was demonstrated that the rate of haemolymph circulation declines progressively as DDT symptoms advance; this occurs despite a normal heartbeat. It was demonstrated further that the CHE-protection effect could be accounted for largely, but not completely, by the abnormal circulation. Also, 20 minutes after injection of TMPP, its concentration in the blood of DDT-prostrate roaches was less than one-half normal. At the appropriate dilution, the average TMPP concentrations in blood from normal and DDT-prostrate roaches caused in vitro inhibitions of 80 and 35% respectively. The results indicate that the phenomenon of CHE-protection is due probably to secondary effects of DDT poisoning and is not directly related to aberrations in the CNS.

It was observed that treatment of the isolated nerve cord with 10^{-3} M nicotine initiated a sequence of events similar to that previously found with TEPP (tetraethyl pyrophosphate). Nicotine treatment was followed by excitation, block and recovery of spontaneous discharge and synaptic conduction through the cercal-giant synapse; the synaptic recovery was unstable. As with TEPP, recovery was accelerated by washing with fresh nicotine. This has been shown to be an effect of aeration. High oxygen tensions (i.e. oxygenated Ringer) greatly increased the rate of recovery of activity. Furthermore, in situ cords with intact tracheae failed to block despite the intense stimulation of activity. Unlike convulsions in the mammalian brain, the described electrical events in the roach CNS following nicotine are not accompanied by increases in ammonia; the mean value was .38 micrograms ammonia nitrogen per 100 mgm. fresh weight. Because of the noted effect of oxygen, the sequence of electrical events following nicotine and anoxia were studied in relation to the distribution of acid-soluble phosphorus. Seven major fractions were found by radiochromatographic analysis. Their tentative identification and percent contribution to the total soluble phosphorus in the isolated cord in oxygenated saline were (1) phosphoprotein contaminant (not counted), (2) unidentified (8%), (3) adenosine triphosphate (37%), (4) adenosine diphosphate (3%), (5) glucose-6-phosphate (3%) plus an unidentified acid-labile component (21%), (6) alpha-glycerophosphate (6%), (7) orthophosphate (23%). Adenosine monophosphate was found only in cords held under anoxia. Electrical silence following five minutes anoxia was accompanied by marked depletion of ATP and the acid-labile component of (5) along with increases in alpha-GP, AMP and orthophosphate. No change occurred at the time of block induced by nicotine. Following nicotine, the recovery phase was accompanied by decreased levels of ATP and alpha-GP and increases in orthophosphate. A comparison of the electrical events and concomitant changes in acid-soluble phosphorus following nicotine and anoxia has led to the hypothesis that (1) the nicotine-induced block of spontaneity is due to a membrane depolarization caused by excess of an excitatory substance which probably originates pre-synaptically during excitation; and (2) recovery of spontaneity is a

dual process involving oxygen possibly in (a) an inactivation reaction of neurohumor, but mainly in (b) an energy-requiring repolarization of affected membranes.

Microfilm $2.75; Xerox $5.40. 109 pages.

THE ELECTRICAL ACTIVITY OF THE HYPOTHALAMUS OF UNANESTHETIZED DOGS AND ITS MODIFICATION BY LOCAL THERMAL STIMULI

(L. C. Card No. Mic 61-2029)

Joseph S. Eisenman, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. James D. Hardy

This work attempts to elucidate further the role of the hypothalamus in the control of body temperature, by application of the technique of recording the electrical activity of neural structures. Electrodes and thermodes were placed in various parts of the hypothalamus of unanesthetized dogs through stainless steel guide tubes implanted in the skull of the animal. Thermal stimulation of the anterior hypothalamus was performed by perfusing the thermodes with warm or cool water, or by passing a low intensity 3 mc. R.F. current through the brain tissue. Electrical activity was recorded with a 6-pole multielectrode lead made of strands of copper wire exposed at their tips and plated with silver.

The electro encephalogram recorded during control periods shows a basic pattern of waves at 2-4 cps modulated by faster activity up to 50 cps. Medial and lateral hypothalamic activity differed in that the lateral recordings showed a more pronounced slow wave pattern.

During hypothalamic or general hyperthermia low frequency, high voltage waves were observed at all recording sites. This was correlated with behavioral relaxation of the animals in this state.

Cooling of the hypothalamus, or general hypothermia evoked a characteristic repetitive spindle-shaped discharge with a frequency of about 30 cps. This was observed in the lateral but not in the medial hypothalamus. These spindle bursts appeared in synchrony with bouts of shivering and with the inspiratory phase of respiration.

In terms of frequency and synchrony with inspiration, these EEG bursts resemble activity recorded by several different investigators in various rhinencephalic structures. On the basis of known anatomical connections between the rhinencephalon and the hypothalamus, and these EEG observations, it is concluded that the spindle bursts recorded in the lateral hypothalamus represent activity in hypothalamic neurons taking part in thermoregulatory responses to cold, and activated by convergence of excitation from hypothalmic thermoreceptors and from the receptors of unknown modality feeding into the olfactory system.

Microfilm $2.75; Xerox $3.00. 50 pages.

A STUDY OF THE RESTING AND ACTION POTENTIALS OF MAMMALIAN CELLS IN VIVO

(L. C. Card No. Mic 61-232)

Geraldine Mariellen Blakely Emerson, Ph.D.
University of Alabama, 1960

This investigation was directed toward (1) measurement of resting and action potentials of gastrocnemius muscle fibers in vivo of decerebrated, unanesthetized male Long-Evans rats (average age, 199 days), and (2) testing with electrolyte solutions the potassium electrode (concentration cell) hypothesis, as applied to biological cells.

All measurements were made with a balanced cathode follower (provided with a switch for making a direct short between the grids, and a circuit for applying a known potential between the grids for calibration, resistance determinations, and grid current determinations) and a balanced direct current amplifier of a cathode ray oscilloscope.

Micropipettes were made from 3 mm. outside diameter Kimax tubing, pulled down to a tip diameter of 0.5 micron or less. These were filled in the cold with 3 molar potassium chloride (previously filtered through a one micron pore fritted glass filter). These micropipettes were examined under the microscope both before and after filling. If visually acceptable, they were checked for electrical characteristics (electrical contact made with silver-silver chloride wires which had no potential difference between them in 3 M KCl)--tip potentials and resistance. None was used for biological measurements which had a resistance smaller than 5 or greater than 50 megohms. A pair, matched for resistance, and no or very small potential difference, was used for biological measurements. No pair was employed which had a potential difference greater than 10 mV in physiological fluid substitutes or extracellular fluid. Many pipettes had zero potential difference between them.

Electrolytes were tested with the same measuring instruments as used for making the biological measurements; none had potential differences consistent with the concentration cell theory of the origin of resting potentials. These were tested (a) with a micropipette against a silver-silver chloride electrode, (b) with two silver-silver chloride electrodes, and (c) with two micropipettes. The highest potential differences recorded were between the micropipette and the silver-silver chloride electrode. These potential differences were several times greater than those between two micropipettes. Since significant differences in potentials were obtained between these two methods, it is concluded that all measurements should be made with identical recording electrodes--in mammalian cells with matched micropipettes.

The gastrocnemii were denervated at the time of exposure of the muscle in order that stimulating electrodes could be placed on the sciatic nerve high in the thigh, and to prevent afferent impulses from passing over the sciatic nerve into the spinal cord when the nerve was stimulated. The settings of the Grass stimulator were adjusted to give a maximal contraction of the gastrocnemius muscle. The preparation was in a screened, grounded enclosure; the animal was not grounded.

One hundred eighty resting potential measurements made from these muscles ranged from 15 to 162 mV, with

a mean of 60.7 mV and a standard error of the mean of 2.7 mV. This range of resting potentials is interpreted as representing individual variation among cells of the same tissue, probably due to some metabolic difference, and also perhaps due to the location of the internal micropipette at different sites in different cells (eg., sarcoplasm, nucleus, mitochondria). Thirty-six action potentials from the same muscles averaged 49.8 mV, with a standard error of the mean of 4.3 mV. There were three types of action potential: (1) less than complete depolarization, (2) complete depolarization, and (3) reversal of the resting potential, or overshoot. Individual measurements ranged from 10 to 128 mV. The mean action potential was 11 mV less than the mean resting potential.

Microfilm $2.75; Xerox $6.00. 122 pages.

CORTICIFUGAL EXCITATORY AND INHIBITORY INFLUENCES AND THEIR PATHWAYS ON NEURONS OF THE DORSAL COLUMNS IN THE CAT

(L. C. Card No. Mic 61-1322)

Suhayl Jibra'il Jabbur, Ph.D.
University of Washington, 1960

Chairman: Harry D. Patton

Influences of the motor cortex on the dorsal column nuclei were investigated by analysis of the response discharge of individual cuneate and gracile neurons to peripheral and cortical stimuli. Glass micropipettes 0.5 to 2 micra tip diameter were used to record single unit activity in the dorsal column nuclei of anesthetized cats.

Following electrical stimulation of the footpads with single pulses, the majority of dorsal column neurons responded with a short and slightly variable latency and followed afferent inputs at high rates. These were, therefore, considered to be excited monosynaptically from the periphery. The remaining neurons did not satisfy the above criteria and hence were considered to be excited via the dorsal column relay, or via the recurrent collaterals within the nucleus or by some other mechanism.

Electrical stimulation of the motor cortex altered the excitability of dorsal column neurons in a number of ways: 1) The motor cortex exerted an excitatory influence on 40 per cent of the units isolated in the dorsal column nuclei. This cortical influence appeared to be direct, since most of the units discharged in response to single cortical shocks with a small and slightly variable latency and faithfully followed repetitive cortical stimulation at rates in excess of 50 per second. 2) The motor cortex exerted a depressive influence on 55 per cent of the units isolated in the dorsal column nuclei. The majority of such units met the criteria of monosynaptic activation by the testing peripheral volley and were considered to be inhibited by the conditioning cortical volley. The remaining units were blocked. The cortical depressive influence appeared to be multisynaptic, since trains of cortical shocks were usually required at conditioning-testing intervals between 50 and 150 msec. In addition, full recovery from depression was attained at conditioning-testing intervals of 150 to 200 msec. 3) Drastic increases in the intensity or duration of cortical stimulus parameters resulted in a reversal of cortical conditioning influence from depressive to excitatory in five per cent of units isolated in the dorsal column nuclei.

Motor cortical excitatory and depressive influences on the dorsal column nuclei had the following characteristics in common: 1) They could be graded, depending upon the relative strengths of the conditioning and testing volleys. 2) They were demonstrated on the spontaneous discharge, as well as the response discharge of some cuneate units to tapping or maintained pressure on the ipsilateral forepaw. 3) They were more efficacious from the contralateral than from the ipsilateral motor cortex.

In animals with transected brain stems, except for the bulbar pyramids, both excitatory and depressive corticifugal influences on cuneate units could still be demonstrated. In animals with sectioned pyramidal tracts on both sides, corticifugal influences on cuneate units could rarely be demonstrated; when present, these influences were weakly depressive. In animals with a sectioned pyramidal tract on one side, corticifugal influences on cuneate units could rarely be demonstrated if the pyramidal cut and the stimulated motor cortex were contralateral to the cuneate nucleus tapped for unit recording; when present, these were weakly depressive. Corticifugal excitatory and depressive influences were readily demonstrated when the pyramidal cut was contralateral both to the stimulated motor cortex and to the cuneate nucleus tapped for unit recording.

The hypothesis is presented that the anatomically demonstrable direct endings of pyramidal tract fibers on dorsal column neurons provide the necessary anatomical substrate for the corticifugal excitatory pathway. Furthermore, the anatomically demonstrable direct endings of pyramidal tract fibers on reticular neurons of the lower brain stem provide the first part of the anatomical substrate for the multisynaptic corticifugal inhibitory pathway.

Microfilm $2.75; Xerox $5.20. 103 pages.

REGULATION OF FUNCTION AND ACTOMYOSIN CONTENT OF CARDIAC MUSCLE BY ESTROGEN

(L. C. Card No. Mic 61-1953)

Theodore Matthew King, Ph.D.
Michigan State University, 1959

Little information is available on the influence of estrogen on heart muscle. This situation exists in spite of the known difference in sex incidence of at least some types of heart disease, the use of gonadal steroids in treatment of heart disease, and the recognized greater longevity of females. This, along with the need for knowledge concerning the mechanism of action of such steroids on the cellular level, stimulated this study.

The effects of estrogen on properties of the myocardium were noted in albino rats treated as follows: ovariectomized; sham operated females; ovariectomized given 0.1 gamma alpha estradiol daily; orchiectomized; sham operated males; and orchiectomized given 1.0 gamma alpha estradiol daily. On the 30th day of treatment the animals were weighed and killed. Heart, adrenal,

uterus or seminal vesicles were weighed and dried. Refractory periods, excitability to square wave stimuli, and active and passive tension curves were determined in vitro on left ventricular columnae carneae.

No significant differences existed in heart weight, heart-body weight ratios or water content of the myocardium. Expected changes existed in organ-body weight ratios for adrenal, uterus, and seminal vesicles. No differences in excitability or refractory periods were noted. Mean-developed tension at a given length was significantly greater in intact females than in castrate females, while developed tension in estradiol-treated castrates approached normal values. In the male groups no significant difference in developed tension was found. Mean-developed tensions of intact females and males were not dissimilar. No differences in passive tension curves existed in any groups.

In an attempt to investigate the mechanisms involved in the reduced contractility of isolated surviving left ventricular columnae carneae of ovariectomized rats, further studies were completed. Glycerol-extracted columnae were prepared, and ventricular actomyosin was quantitatively and qualitatively studied. These studies were completed after 30 days of treatment in sham operated females, ovariectomized females, and the following ovariectomized alpha estradiol-treated groups: 0.1 gamma, 1.0 gamma, and 10 gamma. A 100 gamma alpha estradiol group of sham operated animals was also studied.

Maximal A.T.P. induced tension was significantly reduced in glycerol-extracted fibers of hearts of the untreated ovariectomized group. Tension developed by glycerol-extracted fibers of estrogen-treated groups was significantly greater than the untreated ovariectomized group. Nitrogen content of the glycerol-extracted columnae carneae was not altered in any of the groups.

Actomyosin was quantitatively determined by change in viscosity in response to A.T.P. and by micro-Kjeldahl technique. Actomyosin concentration was significantly reduced in the ventricle of the ovariectomized groups as compared to ventricles of the untreated intact group. Concentration of actomyosin was significantly increased in ovariectomized groups by treatment with estrogen. No qualitative change in contractile protein was found.

It can be concluded that alterations in developed tension in isolated surviving columnae carneae and glycerinated columnae carneae are related directly to quantitative changes in actomyosin concentration. These results indicate a dependence of the cardiac contractile system on estrogen similar to that of the uterus. Further, it suggests a general effect of this hormone on contractile protein synthesis in all muscular tissue. The importance of the gonadal steroids and the gonadal-pituitary axis on muscle development and maintenance should be investigated further.

Microfilm $2.75; Xerox $6.00. 121 pages.

THE MODE OF ACETYLCHOLINESTERASE REGENERATION IN CHOLINERGIC NEURONS AFTER IRREVERSIBLE INACTIVATION BY DIISOPROPYLPHOSPHORYLATION

(L. C. Card No. Mic 61-2044)

Edward Koenig, Ph.D.
University of Pennsylvania, 1961

Supervisor: George B. Koelle

Three complimentary experiments were designed to test the hypothesis of proximodistal convection with respect to the specific enzyme, acetylcholinesterase (AChE). In all three experiments, the regeneration of AChE activity was studied after irreversible inactivation of the enzyme by diisopropylphosphorylation. The regeneration of AChE was followed in various cholinergic structures of the cat over a period of time. Selection of structures was based on obtaining a broad, representative profile of AChE-regeneration in neuronal somata, axons, axonal terminals and a non-neuronal tissue and were as follows: the hypoglossal nucleus and three successive segments of its peripheral nerve, two successive segments of the distal sympathetic nerve and superior cervical ganglion, ciliary ganglion, and inferior oblique muscle of the eye. Acetylcholinesterase activities were determined by a spectrophotometric method.

In experiment I, cats were given a high dose of diisopropylfluorophosphate (DFP) intravenously (i.v.), and sacrificed 1,2,3,5,10 and 15 days after administration of the anti-ChE agent. Enzymic activity was observed to return in equivalent, absolute amounts and in a spatially uniform fashion along the lengths of hypoglossal and cervical sympathetic nerves studied. The regeneration of AChE in the soma-containing ciliary ganglion and hypoglossal nucleus, in contrast, occurred at an equivalent, relative rate.

In experiment II, cats were given a high system dose of DFP, i.v., as in experiment I, but followed, additionally, by daily intraventricular injections of DFP through an indwelling cranial cannula. The cats were sacrificed at 3,5, and 10 days. Suppression of AChE levels in the hypoglossal nucleus was maintained chronically; the enzyme did not increase beyond 34% of DFP-treated controls for the comparative interval per 24-hour period. Although enzyme levels in the nucleus did not exceed 15% of normal control levels at any time during the course of the experiment, AChE in its peripheral nerve regenerated to 80% of comparable normal control in 10 days, indicating the relative somal independence of the peripheral nerve with respect to AChE regeneration. Subnormal levels in many other structures indicated that some encephalically placed DFP found its way into the general somatic system.

In experiment III, an equipotent injection of the non-hematoencephalic-penetrating anti-ChE agent, diisopropylphosphostigmine (DPS) was given, i.v., instead of DFP. The cats were sacrificed at 1,3,5, and 10 days. Despite normal levels of AChE in the hypoglossal nucleus, the rate of regeneration in the hypoglossal nerve was relatively unaffected, indicating further that cytoplasmic AChE was not being conveyed peripherad.

It is concluded that the spatially uniform return of AChE, occurring at an absolute rate in peripheral nerve, could be explained by a mechanism of local precursor

conversion to functional enzyme, or by reconstitution of a DFP-inactivated functional center by substitution of the spurious moiety, or by both. The relative rate of AChE regeneration in soma-containing structures, on the other hand, is very probably a function of de novo biosynthesis of AChE. Microfilm $2.75; Xerox $6.80. 143 pages.

TISSUE DOSIMETRY – MEASUREMENT OF A BETA- AND GAMMA-EMITTING RADIONUCLIDE (Cs^{137}).

(L. C. Card No. Mic 61-1838)

Max Marcell Nold, Ph.D.
Cornell University, 1960

The silver phosphate glass dosimetry system was used in measuring the beta-gamma radiation dose from Cs^{137} to the testicles, muscle, liver and kidneys of dogs. The size of the dosimeter rods (1 x 6 millimeters) permitted surgical placement within the tissues and use of lucite shields allowed measurement and comparison of the beta-gamma relationships from known amounts of ingested radioactivity.

Calibration for the response of the dosimeters to the gamma and beta rays from Cs^{137} was necessary prior to the in vivo measurements. Rods exposed to gamma rays from a Co^{60} source and to Cs^{137} in solution gave almost identical responses of 3.3 and 3.2 fluorescent divisions (F.D.) per rad exposure respectively. Investigation of a series of pure beta emitters of varying energies substantiated the beta response from Cs^{137} of 0.4 F.D. per rad.

Two groups of dogs were used in the in vivo experiments. One group was given a single meal of Cs^{137} and killed after 28 days. The second group was given the radioactivity on a daily basis for a 56-day period. Blood and muscle biopsies were taken for determination of radioactive concentrations throughout the exposure periods and extensive tissue sampling was done at autopsy. The beta dose to muscle, when calculated from the concentration-time data, compared favorably with that measured with dosimeters. It was calculated that the gonads would receive a radiation dose of 0.04 to 0.09 rads per microcurie Cs^{137} ingested based on an exposure time of one year. No difference in the delivered radiation dose per microcurie ingested was seen between the two groups.

Extrapolation of the dog data to man was made. It is calculated that 80 to 190 μc Cs^{137} would deliver the maximum permissible dose (MPD) of 5 rad per year after the age of 18. This range spans the 110 to 160 μc Cs^{137} estimate for standard man computed from NBS Handbook 69 values. Microfilm $2.75; Xerox $9.00. 147 pages.

A QUANTITATIVE STUDY OF PERIPHERAL BLOOD AND BONE MARROW CELLULAR CHANGES IN THE RAT DURING PREGNANCY

(L. C. Card No. Mic 61-736)

Leo Soskind, Ph.D.
New York University, 1958

Adviser: Dr. Albert S. Gordon

The purpose of this study was to examine with modern quantitative methods the peripheral and marrow cellular changes throughout pregnancy in the rat. The relation between these cellular values and alterations in whole blood and plasma volumes was investigated. Preliminary studies were also made of the plasma iron levels during pregnancy and of the blood picture in fetal and newborn rats.

Seventy-five nulliparous female rats of a modified Long-Evans strain weighing between 150 and 170 grams were selected from pooled litters and placed in cages with fertile males. The non pregnant females were used as normal controls. The others were divided into a 3-7 day pregnant group, an 8-11 day pregnant group, a 12-16 day pregnant group and a 17-20 day pregnant group. The non-pregnant group was similar in age, weight and treatment in the laboratory to the experimental animals.

Tail blood was employed for all peripheral cell determinations which included red, white and differential cell counts, as well as reticulocyte, hemoglobin and hematocrit estimations. Blood volumes were determined by the Evan's Blue Dye (T-1824) technique. At the appropriate times, the animals were sacrificed and the right femurs removed rapidly. The bones were split longitudinally and the marrows taken up into a tared pipette. The increase in the weight of the pipette represented the weight of the marrow. This marrow was washed into homologous serum and used for determination of marrow cellular numbers calculated per milligram of marrow, for eosinophil counts using Randolph's stain, and for myelogram smears treated with Ralph's benzidine stain and counterstained with hematoxylin. Additional smears were treated with Wright's stain.

The results indicated that an anemia developed in the rat during pregnancy characterized by a fall in red blood cell numbers of about two million per cubic millimeter which was paralleled by reductions in hematocrit and hemoglobin values. The white blood cell counts also exhibited a diminution but this was significant only in the 17-20 day pregnant group. Leucocytic differential values showed insignificant fluctuations throughout pregnancy. Whole blood volumes and plasma volumes rose as pregnancy advanced. Reticulocytes also increased significantly. Bone marrow cellular numbers, myelograms and myeloid-erythroid cell ratios showed no significant departure from the normal pre-gestational levels. Plasma iron levels descended during pregnancy.

The anemia which accompanies pregnancy is normochromic and normocytic and is attributable at least in part to hemodilution. The cause of the hemodilution is obscure, probably being largely hormonal in origin. It may be considered a normal accompaniment of pregnancy but it may exist together with a true iron deficiency anemia. A survey of the literature indicates that it need

not be a source of concern unless the red blood cells and the hemoglobin descend to the levels characteristic of an iron deficiency anemia. Supportive therapy with iron in the absence of true anemia is of questionable value and may even have injurious effects such as the induction of hemochromatosis or thrombophlebitis and depression of phagocytic activity.

Blood smears from fetal and newborn rats show large numbers of nucleated red blood cells as compared with leucocytes. The reticulocyte numbers are also many times those found in adult peripheral blood.

Microfilm $2.75; Xerox $4.40. 81 pages.

FACTORS AFFECTING THYROXINE SECRETION RATE OF THE FOWL

(L. C. Card No. Mic 60-6824)

Perry Ruth Stahl, Ph.D.
University of Missouri, 1960

Supervisor: Dr. Charles W. Turner

Lines of New Hampshire chickens with hereditary differences in thyroxine secretion rate (TSR) and thyroid hyperplasia were employed in studies on the effect of growth and temperature on thyroid activity, exogenous thyrotropin (TSH) on thyroidal-I^{131} release and thyroid hyperplasia, and inheritance of thyroid function. The hereditary line responding to a goitrogen with greater hyperplasia is the line with the lower TSR. The line with less hyperplastic response to a goitrogen has a greater mean TSR than has the high hyperplastic line. These differential thyroid functions presented a basis for the reactions investigated.

Mean TSR of the high secretion line of mature chickens was 2.97 ± 1.43 μg./100 grams/day during the winter. This declined in summer to 1.24 ± .47 μg./100 grams/day, a 58.3% reduction. Mean TSR of the low secretion line during winter was 1.01 ± .47 μg./100 grams/day, with a 41.6% decline to 0.59 ± .02 μg./100 grams/day in the summer. Growing birds maintained a higher TSR during the summer than did mature birds. Mean of the high secretion line in August during growth was 2.08 ± .18 μg./100 grams/day, of the low line, 1.17 ± .12 μg./100 grams/day.

Exposure to 40° F. did not cause a change in thyroid function as measured by thyroidal-I^{131} release rate, within 8 hours. In 7 birds of a group of 24, no increase in TSR was noted after 32 days exposure, while 5 of the birds reached maximum TSR at this time. Between 32 and 54 days, 14 birds reached maximum TSR, 2 between 85 and 112 days, and 2 birds continued to increase TSR up to 190 days after exposure to cold. In a second group of 18 birds exposed to gradually decreasing winter temperatures before exposure to constant 40° F., 7 showed maximum TSR within 14 days, 2 within 49 days, 5 within 78 days, and 4 continued to increase to 108 days. Of a third group of 11 birds exposed to 40° F. environmental temperature after the spring temperature increase (March 21), 3 birds reached maximum TSR within 28 days. One bird did not increase TSR during 58 days exposure to 40° F. In general, birds with a low TSR during growth reach their maximum response to cold more rapidly and at a lower rate than do birds with a high TSR during growth. Yet in several instances, birds with low TSR continued to increase for long periods and reach a higher maximum TSR.

It is quite unlikely that the slow initial response to cold was a result of slow response to increased TSH secretion. Subcutaneous administration of levels of 0.1, 0.15, and 0.2 unit/100 grams/day to 6 week old cockerels caused release of thyroidal-I^{131} within 4 hours. It is logical to assume that an endogenous increase in TSH would elicit an even more rapid response.

Groups of cockerels were separated as to high and low enlargement in response to goitrogens. All birds were injected with 3.5 μg. L-thyroxine/100 grams/day to inhibit endogenous TSH secretion, and fed tapazole as 0.05% of the ration to produce maximal thyroid enlargement in response to exogenous TSH. Levels of 0.05, 0.075, and 0.1 unit TSH/100 grams/day were administered for 21 days. No significant thyroidal hyperplasia resulted from administration of any of these levels.

A preliminary genetic study indicated the probability of additive gene action in inheritance of thyroid function. Low x low matings yielded low offspring, high x high matings yielded high offspring, and mating high cockerels with pullets of increasing TSR resulted in progeny which increase in TSR proportionately. The process of upgrading toward higher TSR is thus shown to be possible, and feasible, in animals with a short generation time.

The data on thyroxine secretion rate reaffirm the accuracy of the method employed. Use of a 2" Na I crystal in the counting head permitted use of a dose of I^{131} that is far below that shown to be detrimental to the chick thyroid. Repeated use of 40 uc. of I^{131} in mature pullets with no reduction in I^{131} uptake or alteration of thyroxine secretion rate indicates this level to be well within the safety range.

Microfilm $2.75; Xerox $5.20. 104 pages.

POLITICAL SCIENCE, GENERAL

THE AMERICAN SECRETARY OF STATE: A STUDY OF THE OFFICE UNDER HENRY L. STIMSON AND CORDELL HULL.

(L. C. Card No. Mic 60-5044)

Charles Langner Robertson, Ph.D.
Princeton University, 1959

This thesis is an analysis of the role of the Secretary of State in the conduct of American foreign policy, based on a survey of relevant literature and case studies of two Secretaries, Henry L. Stimson and Cordell Hull. The study's main hypotheses are that the actual role of the Secretary cannot easily be delimited in formal terms; that personal conceptions of the role held by the Secretary and the President, their views on foreign policy as problems arise, and the domestic political situation in the United States are the interacting factors that, in each individual case, delimit the Secretary's role, though a core of functions and powers are always passed on from one Secretary to the next.

The Secretary is viewed as having six interrelated potential roles: policy maker; negotiator with foreign governments; administrative head of the Department of State; administrator of foreign operations or coordinator of, or adviser to, other agencies carrying out foreign operations; politician; symbol of the American government. Each of these the individual Secretary may play differently; the way in which he performs any one of them may affect the way in which he can play the others.

A brief survey of literature dealing with the conduct of foreign policy reveals a number of different conceptions as to what the role of the Secretary of State should be. The main differences are to be found in the extent to which the Secretary should integrate policy advice from various agencies and the extent to which this should be done at the Presidential level; and in the extent to which -- and manner in which -- the Secretary should control the conduct of various types of operations. While personal factors are given some attention, most of the recommendations are based on general administrative doctrines.

In contrast to the tenor of these writings, which cover the ten-year span from 1943 to 1953, Stimson's role is seen to be less in question in terms of policy integration and the administration of operations, but highly limited by his policy differences with President Hoover. His poor health precluded energetic performance of other functions, and Democratic predominance in the Senate seemed to him to require his avoidance of strong campaign support of the President, a fact which further alienated the latter. His attempts at improvement of departmental organization and procedure, in these circumstances, did nothing to buttress his policy-making position. In Cordell Hull's time the new problems of integrating policy and operations came to the fore. As they did so the Secretary, unable to cope with them, declined in importance. The excuse usually given was that foreign policy was now primarily military and therefore out of his province, but this was not a sufficient explanation. Again the factors of personality, policy views, and working methods are seen to be crucial, but in this case the domestic political situation as well as the ease of inertia, dictated continued retention of the Secretary. His exclusion from policy making is also shown to be decisive in his inability to integrate operations. In all of these matters his lack of attention to organizing the Department for larger tasks contributed to the decline.

It is suggested that certain conditions, organizational and political, have tended to change the nature of the office in more recent times. But the precise nature of the change can only be assessed through a further examination in terms of these roles.

Microfilm $3.75; Xerox $13.05. 290 pages.

COMMUNISM AND THE NATIONAL PROBLEM IN YUGOSLAVIA

(L. C. Card No. Mic 61-1416)

Paul Snedden Shoup, Ph.D.
Columbia University, 1961

The dissertation examines the problems faced by the Yugoslav Communists in overcoming the antagonisms that have divided the Yugoslav peoples since the formation of the Yugoslav state in 1918. Section I of the study traces the development of the national question prior to the Communists' seizure of power in 1945. Section II deals with the national problem in the period immediately after the Second World War (1945-1947). The struggle of extremist national elements against the new regime is discussed, and the revolt of the Albanians in Kossovo in the fall of 1944 and the spring of 1945 is described. The following problems which also faced the Yugoslav Communists at this time are appraised: the delineation of republic boundaries, the problem of the Serbian colonists in Macedonia, the problem of the Serbs in Croatia, the Macedonian question, and the position of the Catholic, Orthodox and Moslem churches under Communist rule.

Section III deals with Titoism and Yugoslav national policy in the years 1948-1958. Figures presenting the number of defections to the Cominform from each of the national party organizations are analyzed in an attempt to determine if any one of the Yugoslav nationalities was more prone to side with the Soviet Union against the Yugoslav Communist leadership. The effect of the Cominform dispute on the Macedonian question is analyzed and the rewriting of Macedonian history which resulted therefrom is discussed. In addition, the re-evaluation of national policy which followed the introduction of Titoism is described: the de-emphasis of the federal system, the attempt to

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

re-interpret Yugoslav national history, and the efforts of the Yugoslav Communists to promote cooperation in the cultural field among the Yugoslav republics. Special attention is paid to the difficulties that arose when the Yugoslav Communists tried to redeem their pledge of massive economic aid to the underdeveloped republics.

Section IV of this study deals with the national problem in the state apparatus and party in the years 1945 to 1948. A chapter is devoted to the operation of the Yugoslav federal system, and the modifications that were introduced into that system after 1952. The character and extent of national feelings within the party are then analyzed in some detail. It is suggested that the Titoist reforms have encouraged the growth of divisive national feelings within the party, but that the unity of the Yugoslav Communists in respect to the national question is not yet seriously threatened. The use of national cadre is also examined on the basis of information giving the nationality of leading figures in the party and administration at the federal level and in the Republics.

Section V summarizes the position of the Yugoslav Communists on the national question today. One chapter is devoted to the re-interpretation of the Yugoslav national question given by Edvard Kardelj in 1958. A final chapter presents the author's opinions on the nature of the Yugoslav national problem at the present time. It is suggested that national sentiments remain strong but that it is difficult to estimate the importance of these feelings. First, the Yugoslav peoples have developed a strong Yugoslav patriotism. Second, the suppression by the Communists for a decade and a half of all discussion of the national problem has left the people confused and unsure of their own position.

Microfilm $4.80; Xerox $16.90. 373 pages.

THE STRUGGLE FOR NATIONAL UNITY IN THE UNION OF BURMA

(L. C. Card No. Mic 61-1835)

Josef Silverstein, Ph.D.
Cornell University, 1960

The peoples of Burma today, as in the past, are faced with the problem of developing genuine unity in order to provide the basis for a strong and viable independent state. This study of that problem attempts to do two things: provide a brief survey of the major indigenous ethnic groups in Burma and their relations prior to the establishment of an independent Union of Burma and describe and analyze the theoretical, institutional and political developments of the first twelve years of self-government. At the heart of this inquiry is the question of why the weak thread of national unity, which was spun at the Constituent Assembly in 1947, did not and has not yet become an unbreakable cable.

Underlying this question is the fact that there has been little or no formal discussion by the political leaders of the problem and no agreement by them on the course to follow and the goals to seek. From the limited discussion of the problem which has taken place, there appears to be a dichotomy in the thought of the leaders over the meaning of the idea itself. The views of Aung San and the declarations in the Constitution suggest that one means of establishing unity is through the recognition of the principle of unity in diversity — allowing the separate groups to retain their identities and differences in exchange for their loyalty to the nation-state. At the same time, there are those among the present day leaders such as U Nu, who have sought to build unity on the basis of assimilation and integration — creating new loyalties and identities which are shared equally by all and deemphasising those elements which are divisive. It is within the context of these two conflicting ideas — unity in diversity and assimilation and integration — that the struggle for national unity has proceeded.

Following an examination of the factors which have conditioned the growth of national unity — the ideas, institutions, politics and events — during the past dozen years, the study ends with the conclusion that the peoples of Burma are drawing together through the process of assimilation and integration. Through the Burmanization of the minorities and the development of a national ideology, culture, language and sense of identity, the ethnic and historic differences are gradually submerging. The process is far from complete and it will be many generations before popular resistance to it disappears.

Microfilm $7.30; Xerox $25.90. 573 pages.

FEDERAL IMMUNITY LEGISLATION AND THE FIFTH AMENDMENT PRIVILEGE: A LEGISLATIVE AND JUDICIAL HISTORY.

(L. C. Card No. Mic 61-782)

George Dorian Wendel, Ph.D.
St. Louis University, 1960

The privilege against compulsory self-incrimination is a time-honored safeguard of individual liberty, established in England after a long struggle between Crown and Parliament and recognized in the American colonies even prior to the Revolution. Yet the privilege runs counter to another basic principle which holds that the public has a right to every man's testimony when required in the public interest. This study traces, historically and analytically, the efforts of the United States Congress to resolve this conflict between private right and public good by means of compulsory immunity statutes.

The Fifth Amendment of the Constitution protects a person against giving testimony which might incriminate him in a criminal prosecution. Immunity statutes eliminate the danger of incrimination by granting immunity from any prosecution which might result from testimony, thereby also eliminating the justification for invoking the Fifth Amendment privilege.

While known in Great Britain as early as the eighteenth century, immunity statutes did not appear in American federal law until 1857. In that year, charges of corruption among congressmen caused Congress to enact the first federal immunity statute to prevent witnesses from refusing under the Fifth Amendment to give testimony vital to the investigation. The act succeeded in its purpose, and from this particularized beginning, the immunity principle was utilized by Congress on many occasions in the succeeding century. In fact, almost every major federal regulatory act of the last sixty years has embodied an immunity

provision to facilitate any fact-finding necessary for effective administration.

This study not only traces the expanding use of the immunity principle in the last century, but also analyzes the obstacles placed in the way of immunity statutes by the courts. For example, Congress, in acts of 1862 and 1868, shifted the grant of immunity from the matters revealed to the testimony itself. The witness would therefore remain liable for prosecution for the act revealed if the government could uncover its own evidence of wrongdoing. In Counselman v. Hitchcock (1892), the Supreme Court ruled that immunity statutes must be as broad as the protections of the Fifth Amendment privilege to be valid. The Court then found the act of 1868 inadequate under this rule since it immunized only the testimony of a witness, not the act revealed.

In 1893 Congress passed a new immunity act which immunized the act revealed and also established a new model for future immunity legislation by enlisting the immunity provision in the administration of a specific act, the Interstate Commerce Act of 1887. In Brown v. Walker (1896), the Supreme Court by a one vote majority held the act of 1893 adequate under the Counselman Case doctrine, the case standing to the present as the controlling precedent on immunity legislation.

In 1954, Congress passed an immunity law which for the first time in over sixty years extended immunity to matters beyond economic regulation, namely to investigations by Congress and grand juries into threats to national security. The Immunity Act of 1954 was upheld by the Supreme Court in Ullmann v. United States in 1956, but only the grant of immunity in grand jury proceedings was considered. Grants of immunity pursuant to congressional investigations, in which the district court performs a questionable role, have not yet been tested. In addition, the Court's rulings that immunity acts need not protect against state incrimination and public infamy, as well as its reliance on the weak precedent of Brown v. Walker, have been widely criticized.

This study, in general, finds the criticisms of the act of 1954 and the Ullmann Case well-founded, and agrees with the critical consensus that a reappraisal of the entire question of federal immunity legislation by the Supreme Court is definitely in order.

Microfilm $3.30; Xerox $11.50. 254 pages.

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

THE ROLE OF THE AMERICAN TRADE UNION REPRESENTATIVES IN THE AID TO GREECE PROGRAM, 1947-1948.

(L. C. Card No. Mic 61-1315)

Margaret Mary Davies, Ph.D.
University of Washington, 1960

Chairman: Professor Linden A. Mander

The purpose of the dissertation is to attempt to show one aspect of the birth of a new idea in world political history, a relationship of people across the boundaries of sovereignty of the nation-state, through the device of examining the work of two men who were somewhat more aware than their colleagues that they were all acting in the capacity of midwives. The study presented here is an eyewitness account of the work of the two trade unionists who were the labor advisers of the American Mission for Aid to Greece, 1947-1948, the first move of the United States to halt Russian aggression.

Assessment of their role has been undertaken because the appointment of trade unionists was the most notable procedural break with diplomatic precedent in the structure of the Mission and their assignment an embodiment of the new, and American, approach to world affairs. Implicit in the Greek assistance program was recognition that the continued existence of poverty and abundance side by side in a society or in the world could be tolerated only at great peril to western civilization.

America faced a grave handicap in her initial action as a great power: a lack of experience in dealing with persons of any culture other than her own. It was hoped by the career men who planned the aid to Greece program that a "tie of workmanship" between American and Greek professional and technical experts might bridge the gap of cultures and ease the tensions between supervisor and supervised.

In this regard the work of the labor advisers is particularly noteworthy for they not only worked with the Minister of Labor but, unlike any of their colleagues on the Mission, as representatives of a non-governmental agency in the United States they were charged by their government with working with a non-governmental sector of Greek society, that of the members of the Greek labor movement.

The contribution of the labor advisers can be summarized under three categories. First, they gave vital assistance in the re-establishment of the General Confederation of Greek Labor, not, it is true, on a foundation they found entirely satisfactory but one which was free from Communist influence and in which the forces of government control were at least evenly countered.

Second, they contributed immensely to the control of inflation. They established wage rates for the American contractors which were reasonably related to other construction work in Greece. Even more importantly, they were responsible for the drafting of a Master Collective Agreement on wages for all private employes in Greece. Probably only bona fide trade unionists could have called forth sufficient trust in American officials and in the Greek government to warrant signature by the Greek Confederation of Labor of an arrangement which froze wages without at the same time creating a comparable price control mechanism.

The third and most important contribution the labor advisers made was in a less tangible area but was probably the most vital of all. They became a living, functioning proof that the American government was concerned with what happened to the ordinary Greek citizen. The "tie of workmanship" proved valid.

In Greece, which was a preliminary to the Marshall Plan, the work of the American trade unionists convinced the architects of the Economic Cooperation Administration that American labor had a vital contribution to make in American foreign affairs.

Microfilm $7.10; Xerox $25.20. 558 pages.

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

THE ADMINISTRATIVE MAN IN A RESEARCH AND DEVELOPMENT ENVIRONMENT

(L. C. Card No. Mic 61-1700)

Edward Joseph Jones, Jr., D.P.A.
University of Southern California, 1961

Chairman: Professor Sherwood

This dissertation is concerned with the part played by the administrative employee in the environment of a large governmental research and development enterprise. The role is rather a new one for the person with administrative skills. Especially in the past decade there has been groping for mutual understanding between the technical man and the administrative man as they struggled to devise a human organization capable of dealing with the rapid, wrenching change that has characterized the research and development process. It is readily evident that the transformation of research and development into the multibillion-dollar base of our industrial growth has been and will continue as traumatic for the administrative employee as for the scientist and engineer.

The culture of a governmental research and development laboratory is examined in historical perspective. Emphasis is placed upon the demands which the development of new technology makes upon the administrative process. Administrative practices in modern industrial society evolved in a climate quite different from that which characterizes research and development. Where research and development emphasize change, administration has been identified with predictable and orderly process. Selected samples of staff activities, including employee development, management research, and communications analysis, are used to demonstrate new administrative approaches in a laboratory setting.

Responses to an interview schedule and a detailed questionnaire are analyzed. Interviews were done with forty-two of the key technical and administrative personnel concerned with the development of a major missile system. There was evidence that the administrative staff did not attain the level of emotional involvement in the project that characterized the technical man.

The attitude questionnaire was distributed to 155 administrative personnel and 123 were returned completed. When compared with earlier responses of over 800 technical personnel, these served as a basis for testing the validity of a concept of administrative distance which hypothesized a difference in understanding, expectations, values, and traditions between the administrative and the technical man. Substantial differences were identified. There were tangible differences in age, sex, tenure, experience, and education. No less critical were differences in attitude toward career, government employment, job conditions and toward the experimental approach to decision making. There was evidence that the administrative man was more likely to accept the bureaucratic milieu of civil service employment, far more likely to orient himself to the organization than the technical man whose loyalties tended to be more cosmopolitan and professionally oriented.

The evidence accumulated provides support for several generalizations: (1) The classical approach to administration oriented to the needs of productive industry required major modification before it was accepted in the research and development environment. (2) Where the administrative man was unable to provide dramatic new ideas for dealing with the problems of management of research and development, he could expect to be assigned essentially clerical chores and second-class citizenship in the organization. (3) An urgent need was identified to introduce into the laboratory an increased number of professionally prepared administrators able to command the respect of the technical community. (4) Administrators were handicapped by the lack of a central discipline and by the Jacksonian view, prevalent in our society, that any intelligent person should be able to administer the affairs of government. (5) Administrative distance between the technical man and his administrative counterpart would not be readily eliminated, even if differences in age, sex, tenure, and level of education were not present. The contrasting values and attitudes may serve as a creative force in the growth of the organization where they operate in a climate of acceptance and mutual confidence.

Microfilm $3.15; Xerox $11.05. 243 pages.

INCENTIVES IN AMERICAN PUBLIC EMPLOYMENT

(L. C. Card No. Mic 61-2058)

Saleem Mohammad Misbahuddin Qureshi, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. James C. Charlesworth

Incentives in public employment have received scant attention; hardly any work has been done on them. Some literature does exist on incentives in industry, but most of it relates to the form of payment based on the quantity or quality of production.

Most personnel administrators, in government as well as industry, consider a program of incentives containing some awards -- cash and/or certificate -- as adequate. Hardly any effort is made to assess the effectiveness of any program, nor does any literature exist on the past experiments with regard to their success or failure and the causes thereof. A general tendency exists to assume that an incentive program has the same importance for the employees which the management considers it has for them.

Most of the information and material has been obtained from the rules, regulations, manuals, pamphlets, brochures, handbooks, bulletins, and news releases of various kinds issued by different government agencies, and interviews with employees and officers.

Induction, which includes recruitment, examination, registration, certification, appointment and placement, is generally handled in a way which has come to make public employment a decentive. Time taken from the beginning to the end of the process is sufficiently discouraging. It has been reported that in this test of endurance the rate of mortality has been very high -- particularly for talented candidates since the employment market is not limited for them.

Induction, being the first point of contact between the candidate and employer, needs strong incentives to attract the kind of candidates which public service requires.

Employee development, which includes training, performance evaluation and promotion, offers almost no incentive to public employees under the present set up. These personnel procedures are usually considered a part of normal duties. The fact that these procedures can have strong incentives for employees seems to escape the notice of personnel administrators in most cases and in most agencies.

Government offers better salaries for low echelon employees, as compared to salaries in private enterprise, but the salaries for high echelon employees fall short of what are offered outside for comparable work. Salaries, as such, have incentive for low echelon employees but not for those upon whom really depends the quality of work.

Fringe benefits are liberal, sometimes even generous. They are considered to be strong incentives. It was found that they help in retaining a large number of employees by making employment attractive for them.

The Federal Government has a large number of cash and honorary awards. Although it can not be asserted that employees are eager to earn them, yet it cannot be denied too that they do motivate the employees to superior performance.

The basic structure of awards programs remains the same at state and local levels, but the number of items varies from jurisdiction to jurisdiction.

Incentives in public employment can be increased by eliminating all unnecessary wastage of time. Examinations should be announced when vacancies exist. Successful candidates should be appointed without delay. Examinations should be changed; instead of relating to the particular job they should judge the whole personality and the potential for growth. Ladders should be so established that a reasonable candidate may look hopefully to reach the summit if he works effectively.

Training, performance evaluation and promotion should be related to each other. Superior performance should lead to selection for training; successful completion of training should increase the chances of promotion. By linking performance evaluation and training to promotion employee welfare can be secured. Isolated from one another they lack incentive because incentive for the employee depends upon his welfare.

Salaries for high echelon employees will not have an incentive value unless they are raised to a level where they can take care of the normal requirements of life of the employee and his family, and enable him to maintain a social status demanded by the society.

Fringe benefits and awards do not need any radical change, only awards should be more discreetly directed to those levels of employees where they can arouse maximum response. Microfilm $2.75; Xerox $9.45. 206 pages.

PSYCHOLOGY, GENERAL

A FACTOR ANALYTIC STUDY OF PERCEPTUAL AND PERSONALITY RIGIDITY TESTS

(L. C. Card No. Mic 61-1562)

Daniel Joseph Baer, Ph.D.
Fordham University, 1961

Mentor: Joseph F. Kubis, Ph.D.

The purpose of the present study was to investigate the relationship between objective tests of visual perception and questionnaire measures of rigidity. As a general hypothesis, it was suggested that people who respond to one set of stimuli in a "rigid" or "flexible" manner would respond to other stimuli in a similar manner.

To explore this problem, a 36 variable test battery, consisting of 6 rigidity questionnaires, 16 visual perception tests, 10 personality scales, and 4 scholastic ability tests was employed. The perception and rigidity tests were selected on the basis of promising leads from previous investigations as well as on a priori considerations of their potential usefulness as measures of constricted performance.

A homogeneous sample of 100 male college students was selected as subjects. Except for the four scholastic ability tests, the data of which were already available from previous studies, the entire battery was administered to the subjects in group sizes ranging from one to ten students. The tests were distributed among five fifty-minute sessions on the basis of interest value, content, and time limit, and the sessions were extended over a several day period.

All of the scores were punched on IBM cards, and then processed on an IBM 650 computer. The 36 variables were intercorrelated and the resulting Pearson "r" matrix was submitted to the Complete Centroid Method of factor analysis. Using Guilford's criteria, fifteen significant factors were extracted. Orthogonal rotation was then accomplished by means of the Quartimax Method.

Each of the factors was examined for high loadings above an absolute value of .200 and eleven of them were subsequently identified and interpreted. The three factors, identified as Anxiety-Rigidity, Social Flexibility, and Acquiescent Response Set, were found to be independent of the perception and scholastic ability tests. The three factors, identified as Spatial Orientation Flexibility, Perceptual Perseveration, and Speed of Closure, were found to be independent of the personality questionnaires and scholastic ability tests. For the two factors, identified as Verbal Comprehension and Mathematics Background, it was found that they represented traits independent of those measured by both perception tests and personality questionnaires. For the remaining three factors, identified as

Figural Spontaneous Flexibility, Speed of Symbol Discrimination, and Set Rigidity, there was found a low but consistent representation by both perception and personality scales.

On the basis of these results, it was concluded that rigidity and flexibility are neither unitary nor pervasive personality traits that enter into all forms of behavior. It was also suggested that visual perception and scholastic ability tests are not promising measures of personality rigidity or flexibility.

Each of the identified factors was also evaluated in terms of their consistency with findings of previous studies, and promising extensions of the present study, as well as suggestions for future research, are discussed.

Microfilm $2.75; Xerox $5.00. 100 pages.

DEMAND FOR CERTAINTY, MOTIVATION, AND THE DECISION PROCESS.

(L. C. Card No. Mic 61-1722)

Nathan Brody, Ph.D.
University of Michigan, 1961

Whenever an individual is in a situation in which he has several alternative responses available and only a single response is permitted, he is faced with uncertainty. The attempt to reduce uncertainty is called demand for certainty. The present investigation is concerned with the effect of demand for certainty on the decision process and the relationship between individual differences in motivation and demand for certainty.

Two measures of strength of motivation are used in the present study: the thematic apperceptive test of n Achievement; and the Test Anxiety Questionnaire. Two experimental situations are investigated: probability learning and sequential decision. In the probability learning experiment the subject is asked to predict repeatedly which of two stimuli will be presented. In the sequential decision experiment, the subject is presented on consecutive trials with an increasing amount of information that is relevant to a decision he must make. Three measures of demand for certainty are obtained from the experiments. In the probability learning experiment, high demand for certainty is assumed to lead to a greater departure from the equiprobable prediction of the two stimuli than low demand for certainty. In the sequential decision experiment, high demand for certainty is assumed to lead to a more rapid rate of decrease of uncertainty than low demand for certainty. High demand for certainty is also assumed to lead to the requirement of a lower level of uncertainty before a decision can occur.

The correlations among the three measures of demand for certainty were obtained. The level of uncertainty at the time of decision and the rate of decrease of uncertainty were negatively correlated with each other, as predicted. Subjects who eliminate uncertainty rapidly tend to decide at lower levels of uncertainty. The two measures of demand for certainty obtained from the sequential decision experiment were not, however, significantly related to the measure of demand for certainty obtained from the probability learning experiment.

Niether n Achievement nor Test Anxiety were significantly related to performance in the probability learning experiment. In the sequential decision experiment, on the other hand, high n Achievement and high Test Anxiety lead to a more rapid rate of decrease in uncertainty than low n Achievement and low Test Anxiety. High n Achievement and high Test Anxiety were also associated with lower uncertainty at the trial of decision than low n Achievement and low Test Anxiety. These results were interpreted as follows: strong motivation which increases the importance of a decision, to an individual, produces a greater demand for certainty than weak motivation.

The sequential decision experiment was also analyzed from the point of view of how achievement related motivation should influence risk-taking behavior. Subjects whose motive to achieve success was greater than their motive to avoid failure (High n Achievement-Low Test Anxiety subjects) tended to decide in the intermediate quartiles of the distribution of reported confidence at time of decision (intermediate risk) significantly more often than subjects whose motive to avoid failure was greater than their motive to achieve success (Low n Achievement-High Test Anxiety subjects). In order to deduce this result from theory concerning achievement motivation and risk-taking behavior it is necessary to assume that subjects in the intermediate quartiles of the obtained distribution of confidence at time of decision have a subjective probability of success which is close to .50. This assumption was not supported by the self report measures of confidence obtained in the present experiment.

It is felt that this dissertation provides a framework for future research relating motivation to cognition.

Microfilm $2.75; Xerox $6.20. 129 pages.

AN EXPERIMENTAL STUDY OF THE DETERMINANTS OF AFFILIATION IMAGERY IN THEMATIC APPERCEPTION STORIES

(L. C. Card No. Mic 61-1434)

Josiah Boggs Dodds, Ph.D.
Cornell University, 1960

An experiment was designed to test the notions that children's fantasies are either primarily wishfulfilling or are stimulated by prior pleasant experience. The type of fantasy investigated was affiliation imagery in thematic apperception stories.

Fourty-eight sixth-grade subjects were individually given a thematic apperception test of three pictures, which had been found to elicit affiliation imagery, and then were exposed to one of three, ten-minute experimental conditions: Being accepted by a group of four strange peers (who were previously trained to be accepting), being ignored by a group of strange peers (the same children, trained to ignore the subject), or being isolated. The sixteen subjects in each experimental condition were balanced for sex, intelligence, socio-economic status, and classroom sociometric status. Following the experimental condition the subjects made up stories to three more pictures and to a story stem.

The wishfulfilling hypothesis predicts that the accepted

subjects would have less affiliation imagery after the experimental condition than before, and the ignored subjects would have more. The stimulation hypothesis states that the accepted subjects would increase their affiliation imagery and the ignored subjects would decrease their affiliation imagery, since being ignored would be an unpleasant experience which the subject would not desire to carry over in his fantasy. Neither hypothesis predicts changes in the affiliation imagery of the isolated subjects.

Analysis of the group interaction and a post-experiment interview revealed that the experimental conditions conformed to the plan. The accepted subjects tended to have the same amount of affiliation imagery after the experimental condition as they had before, the ignored subjects tended to increase their affiliation imagery, and the isolated subjects tended to decrease their affiliation imagery. However, a 2x3x2 analysis of variance (sex, experimental condition, popularity) failed to show any statistically significant main effects or interactions. Thus, none of the major hypotheses was supported.

Though the reliability of scoring affiliation imagery in the stories was satisfactory, it was found that the subjects' affiliation scores on the stories they told before and the stories they told after the experimental conditions were unrelated.

A secondary analysis of the data revealed that the first-born and only-child subjects had a significantly greater increase in affiliation imagery after being with the collaborators in both the accept and ignore conditions than did later-born subjects. Because other investigators have found relationships between sibling position, reaction to anxiety, and affiliative behavior, it was argued that these subjects found the experimental condition of meeting strange children anxiety arousing and their usual method of handling anxiety--whether desiring to be alone or with others--is reflected in the amount of affiliation imagery they have in their thematic apperception stories.

Conclusions

1. Affiliation imagery in thematic apperception stories is not a direct reflection of recent affiliative experiences such as those given the subjects in this study.
2. Scoring thematic apperception stories for affiliation imagery is an unreliable method of assessing any assumed general affiliative trait.
3. a) Affiliation imagery in thematic apperception stories results from an interaction between subject characteristics and situational factors.

   b) Specifically, affiliation imagery in thematic apperception stories is a reflection of the interaction between an anxiety arousing situation, the subject's anxiety level, and his usual method of handling anxiety (whether he turns toward or away from people --which is roughly indicated by his ordinal position).

Microfilm $2.75; Xerox $5.20. 105 pages.

JOB SATISFACTION AND JOB PERFORMANCE WITHIN A UNIVERSITY FACULTY

(L. C. Card No. Mic 61-13)

John Bodley Ferguson, Ph.D.
Cornell University, 1960

Brayfield and Crockett list five major influences that would act as barriers to the discovery of a relationship between job satisfaction and productivity in industry. If their analysis is correct, in order to demonstrate such a relationship one must look for it in an area where the effect of these influences is severely modified. A university faculty appears to be a body in which they are minimized.

Two hundred twelve faculty members at the University of Hawaii completed a questionnaire which included forty two job and personal items as well as the Brayfield-Rothe job satisfaction index. Respondents were dichotomized according to their responses to the questionnaire items. Mean job satisfaction scores of the group answering in one fashion were compared with mean scores of the group answering in another, and critical ratios were computed.

Since conditions surrounding the promotion system at the University of Hawaii gave this criterion a validity that might not exist in other promotional systems, productivity was measured by whether or not the individual was promoted in 1959. No relationship was found between productivity, as measured by 1959 promotion, and job satisfaction scores. It was concluded that the transfer to the academic situation had not eliminated the effect of two of the influences mentioned by Brayfield and Crockett, and that this was sufficient to prevent the demonstration of a relationship between productivity and job satisfaction.

Past reward, however, was found to be accompanied by higher job satisfaction scores. Among those considered for promotion in 1959, those who had also been promoted in the past showed significantly higher job satisfaction scores than those who had not been promoted in the past. It was concluded that present productivity is associated with higher job satisfaction if past productivity has been rewarded, but by lower job satisfaction if it has not.

Statistically significant relationships between job satisfaction scores and some of the forty two other factors were found. Most pervasive was the influence of rank: higher-ranking faculty showed higher job satisfaction scores than did the lower ranks, and longer service was accompanied by higher job satisfaction scores. Other statistically significant relationships, some holding good in the upper ranks and others in the lower ranks, tended to form a pattern which pointed to the conclusion that the lower-ranking faculty member sees his job much differently than does his higher-ranking colleague, and that this difference can have unexpected consequences if not taken into account when making administrative decisions. The study seems to indicate, for example, that no increase in job satisfaction level could be expected if sabbatical leave were granted to instructors.

Many expected relationships did not materialize. The study was unable to show that teaching loads, office facilities, or academic degrees were associated with differences in job satisfaction levels.

Microfilm $3.25; Xerox $11.50. 252 pages.

SOCIAL STATUS FACTORS AND ACHIEVEMENT NEEDS AS RELATED TO ENTRY INTO A PROFESSIONAL FIELD

(L. C. Card No. Mic 61-1968)

Stewart Gordon Hollyer, Ph.D.
The University of Nebraska, 1961

Adviser: Charles O. Neidt

The purpose of this investigation was to study the relationships among social status variables, achievement needs, and entry into professional training on the advanced collegiate level. The variables measured in this investigation included the student's objective status origins, as determined by the status of his parents, his perceived or subjective status, and his achievement needs. Six professions were selected as being representative of old, new, and semi-professions as defined by Carr-Saunders (1955). The old established professions included law and medicine; the new professions included psychology and engineering; and the semi-professions included social work and pharmacy.

Basic to this study was the assumption, derived from Reiss' investigation (1955), that the professional groupings of old established, new, and semi-professions represent a hierarchy of mobility levels from high to low. A high mobility level profession is one of relatively low status in the community, in which barriers to movement within and without are relatively flexible. A low mobility profession is one which is well established in the professional and sociological community and in which there are high restrictions and requirements placed for entry or movement within or without. The new professions fall somewhat between these extremes and are relatively more established in the community than the semi-professions and therefore have slightly higher barriers to entry and movement within or without.

The sample for this investigation included 334 students in advanced training in various midwestern universities, who were studying in the fields of law, medicine, psychology, engineering, social work, and pharmacy. The sample number was approximately equally divided among the six professions.

Instruments employed for the investigation included a modified adaptation of the Warner Index of Status Characteristics, a measure of objective status, the Sims Social Class Identification (SCI) Scale, a measure of the student's subjective or perceived status, and the Need for Achievement Scale of the Edwards Personal Preference Schedule. The working hypotheses for this investigation were as follows:

1. As status level increases, the rate of entry into low mobility professions increases.
2. As status level decreases, the rate of entry into high mobility professions increases.
3. As status level approaches central tendency, the rate of entry into a moderate mobility profession increases.
4. Holding status constant, the lower the mobility level of a profession, the greater the need for achievement necessary to enter the profession.
5. Holding status constant, the higher the mobility level of a profession, the lower the need for achievement necessary to enter the profession.

Results of the statistical analyses were significant and supported the hypotheses of the investigation for all groups studied with the exception of psychology, which had significantly higher need for achievement scores than the other professions. The psychology group also had relatively high subjective status scores in comparison with the other professional groups studied. With regard to the other professions, the status and need for achievement means ranked from high scores for the old established professions to low scores for the semi-professions, as hypothesized.

It was concluded that status variables and achievement needs are factors related to entry into professional training. Further research is suggested to investigate the deviations from the hypotheses found in the psychology group. Research might also be conducted using different professional groups in addition to those included in the present study. Attention could also be given to investigation of status variables and achievement needs as they relate to persons already practicing in the professions.

Microfilm $2.75; Xerox $6.00. 124 pages.

PERSONALITY AND INTERESTS OF AIR FORCE PERSONNEL

(L. C. Card No. Mic 60-512)

Martin A. Mendelson, Ph.D.
New York University, 1957

Adviser: Walter Wilke

The retention of trained personnel at the skilled level is a continual problem to the Air Force. This study was designed to investigate the desirability of using factorial tests of personality and interest as supportive instruments to tests of aptitude and proficiency in the Department of the Air Force with a view toward early recognition of those basic airmen who could most readily absorb technical training, who would qualify for advancement to supervisory levels, and who would be most likely to make the Air Force a career.

While most qualified observers agree that personality characteristics and interest patterns are related to job performance, the results of previous research on Air Force populations concerning the relation between these variables and job success have not been encouraging. In the belief that the lack of positive results was due to the use of inappropriate instruments, the writer utilized factorial tests to investigate the relation between measured personality and interest categories and the job performance of 279 non-commissioned officers. In pursuing this investigation, the non-commissioned officer group was compared with a reference group of 250 basic airmen. It was hoped that if a sufficient number of trait scores were found to differentiate significantly between the two groups, these trait scores could be used as the basis for developing effective non-cognitive tests for selection and classification purposes.

The two principal instruments utilized were the Jenkins Personality Test and the Jenkins Interest Test. The scores on 119 personality categories and fifty-two interest categories were obtained for both the non-commissioned officer group and the basic airman group. The test scores were processed and tabulated by IBM methods. The tetrachoric coefficient of correlation was then applied to the data to determine whether there were significant differences between the two groups.

The results obtained showed that on seventy-five personality categories out of a total of 119, the groups differed significantly at or beyond the .05 level of confidence. Of these categories, sixty-three were significant at or beyond the .01 level of significance.

Of the fifty-two interest categories, twenty-seven were found to differentiate between the two criterion groups at or beyond the .05 level of significance.

The large number of personality categories differentiating the two groups supports the hypothesis that the non-commissioned officer group is relatively distinct personality-wise from the undifferentiated basic airmen. Similar differentiation between the two groups on interest categories tends to reinforce this proposition.

Biographical data on the non-commissioned officer group showed little correlation with personality and interests.

Results on the job proficiency test given to the non-commissioned officer group showed negligible relationship with personality and interests.

Significant relationships were found to exist between certain personality and interest categories and several types of job family groupings. However, the number of categories for which the relationships were significant were too small to indicate other than tentative findings with reference to occupational differences. This may be due to the small number of non-commissioned officers tested who were engaged in the specific Air Force specialties tested.

On the basis of the tests used as measuring devices in this study, there seems to be substantial evidence that there are significant differences in the personality and interest characteristics of the non-commissioned officer group tested as against the basic airman group tested. It therefore seems clear that in the interests of producing a more stable Air Force population with attendant benefits in terms of economy and organizational efficiency, further exploratory work is indicated on larger and more comprehensive samples regarding the particular applicability of factorial tests of personality and interest for selection and classification.

Microfilm $2.75; Xerox $5.40. 109 pages.

ENGINEERS AND MANAGERS: A STUDY OF ENGINEERING ORGANIZATION.

(L. C. Card No. Mic 61-1119)

Raymond Richard Ritti, Ph.D.
Cornell University, 1960

Human relations in three mechanical engineering departments of a research and development laboratory of a large corporation were studied. A total of 61 engineers, managers, and technical support people were interviewed using a free-structured technique. Additional data were obtained by observation of work activities within the departments.

The major thesis advanced in this study is that of technological determinism. By this it is meant that the pattern of technology in an engineering organization largely determines human relationships within that organization. The principle aspects of the pattern of technology are:

1. The level of technological sophistication of the work assignments given technologists.
2. The job flow. The way in which a project passes through the organization on its progress from initial inception to final manufacture.
3. The degree of specialization of job assignments.

Several examples of technological determinism are given. It is shown that the status relationship between the mechanical engineers and their electrical colleagues is a direct result of the work flow relations between the two groups.

A lack of differentiation between the level of technological sophistication of the assignments of engineers and those of their technical support people creates another status problem. Engineers are dissatisfied doing the same kind of work as their lower status assistants. The technicians are also unhappy with the situation. Since they are doing engineering work, they feel that they should have the same classification.

The second major force operating on human relations in an engineering organization is that of management. Management has freedom of action only within the limits set by the pattern of technology. Two aspects of management are examined. First, the interpersonal aspect; the manager's style of leadership. Second, the manager's ability to influence the course of departmental affairs. Through influence, the manager may obtain favorable treatment for his subordinates.

The role of management in an engineering organization is seen primarily as the manipulation of the pattern of technology, and this is directly related to managerial influence. The interpersonal aspect of managerial behavior is seen to be secondary to and dependent upon the pattern of technology. The manager who is able to manipulate technological assignments to the satisfaction of the work-oriented goals of his people will have not only a more satisfied, but a more productive engineering group as well.

In conclusion, productivity and job satisfaction are seen to be related through the instrumentality of individual goal achievement to the engineer. Where the accomplishment of organizational goals is perceived by the engineer to be instrumental to the achievement of his own work-oriented goals, productivity should be accompanied by increased job satisfaction. Where management sets goals which involve an unsatisfactory pattern of technology, the engineer will be dissatisfied with his assignment and will perceive himself to be unproductive.

Microfilm $3.50; Xerox $12.40. 271 pages.

VALENCE, EXPECTANCY AND DISSONANCE REDUCTION IN THE PREDICTION OF ACHIEVEMENT STRIVING

(L. C. Card No. Mic 61-2062)

Marvin Rosen, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. James Diggory

It was the purpose of this study to specify the relation between expectancy, valence, and achievement striving as reflected in measures of choice behavior and performance. The intensity of achievement striving toward a vocational goal was considered to be a joint function of the valence of that goal and the subjective probability of attaining it. Ordered group predictions from this model were tested by the experimental manipulation of three levels of probability of success (Ps) and two levels of valence (Va). A dissonant relation between these two variables was hypothesized as the basis for dissonance reduction mechanisms such as valence change and disbelief of Ps rating. It was presumed that these changes would affect the intensity of achievement striving and that efficiency of prediction would be increased by adjusting the model to allow for alteration of Va and Ps.

One hundred and forty male high school students, who had volunteered for a free aptitude testing program, served as subjects. On a preliminary questionnaire, completed about a month prior to the actual running of the experiment, each subject was asked to choose five occupations and place them at appropriate points along a linear rating scale so that equal intervals of attractiveness between the occupations were approximated. Subjects were randomly assigned to one of six treatment groups. This assignment determined whether the subject would be given information about a neutral or high valenced occupation (designated the experimental occupation) and the Ps rating he would receive (high, fifty-fifty, or low). The Differential Aptitude Tests (DAT) were administered and subjects were asked to return to receive preliminary results and to complete testing. At this time they were given falsified test results and Ps ratings for the experimental occupation. A second questionnaire was used to measure valence change, disbelief, and other possible mechanisms of dissonance reduction. A special acceleration program was announced to give a few highly qualified students the opportunity to achieve their vocational goals in a shorter time than is now possible. Subjects were asked to state whether they would return for a battery of qualification tests for acceleration in the experimental occupation. A digit symbol performance test, allegedly part of this battery, was administered. Subjects were also asked whether they would return for further information about their test results. Finally, they were informed that they had been given false test results as part of a psychological experiment.

The percentage of individuals choosing to take the acceleration program examinations increased as a function of Ps and Va. Predicted group ordering was exactly reproduced. There was some tendency for subjects in uncertain (fifty-fifty) Ps groups to complete more digit symbols than those in high and low Ps groups. As predicted, valence change and disbelief occurred most frequently under high Ps-Va dissonance conditions but also occurred as a function of low Ps alone. Subjects given uncertain Ps ratings were most likely to make excuses about their test results and to devalue the tests. Those subjected to high dissonance conditions showed a significantly greater tendency to return for further information than subjects under low dissonance conditions. When predictions were revised to allow for change in Ps and Va, the efficiency of prediction was sizeably increased.

It was possible to conclude that a theoretical model of achievement striving based on Ps and Va of the goal could adequately predict experimental results. The frequency with which certain dissonance reduction mechanisms operate in goal-directed behavior is a function of the discrepancy between these same variables.

Microfilm $2.75; Xerox $3.60. 62 pages.

THE DEVELOPMENT OF ATTITUDE SCALES TO PREDICT ACCIDENT REPEATER AND MOVING VIOLATOR DRIVERS

(L. C. Card No. Mic 61-1707)

Donald Herbert Schuster, Ph.D.
University of Southern California, 1961

Chairman: Professor Guilford

The goal of this dissertation was to develop and check attitude scales to predict drivers with moving violations and accidents. A secondary scale was to be developed to detect faking tendencies.

An extensive review of the literature was made to determine the biographical and psychological characteristics of drivers with many moving violations and accidents. Those characteristics reported at least twice were selected for further investigation. Traits from the Guilford-Zimmerman Temperament Survey and the DF Opinion Survey most similar to these selected characteristics were included in the experimental tests. Biographical items were included, but aptitude scales were not.

The temperament and opinion scales were limited in number of items, but reliability (split-half, corrected) was kept above 0.65. One test booklet, called the General Attitude Survey, contained 300 items from 20 temperament and motivational scales. The second test booklet, called the Driver Attitude Survey, contained 104 items. In this booklet were 65 experimental items (for traits of attentiveness, lawlessness, risk-taking, frustration, and emotional perseveration), 20 biographical items, 10 driving-reaction items, and 9 items related to accident involvements.

Drivers of many types took the attitude surveys. Over 2,000 subjects were tested at the local Department of Motor Vehicles, Personal Traffic Safety classes, several insurance companies, several military bases in the area, several local industries, and the University of Southern California. The drivers' violations and accidents were checked both by the subjects' reports and through the Department of Motor Vehicle records.

The drivers were classified as better than average or as problem drivers. Those whose driving records showed an intermediate number of violations were omitted. Problem drivers were classified into one of three accident types and/or one of four violator types, depending upon severity.

Only Caucasian, male drivers in good health who had been driving in California at least three years and who usually drove only a car (and not a truck or bus) were included in the survey item analysis. Since the problem-driver groups varied in age and annual mileage, a better-than-average subgroup was selected from drivers who were younger and who drove more than the other better-than-average drivers in the comparison group.

The 395 items were analyzed for differences by driver group. Items significantly different beyond the 5 per cent level between the driver groups were screened further for the effects of age and annual mileage. Items were retained only if not significant beyond the 20 per cent level on age and annual mileage within the comparison driver groups. A Violations-attitude scale was comprised of items significant for discriminating at least two of the four violator groups. An Accidents-attitude scale was comprised of items significant for discriminating at least two of the three accident driver groups. Three validity scales were developed.

Four groups not used in the item analysis and previously screened out were used for cross-validation purposes. These were drivers with physical or mental health problems, nonwhite drivers, truck drivers, and women drivers. Drivers with poor health, nonwhite or truck drivers could be discriminated with 70-80 per cent accuracy with respect to their violations by the Violations-attitude scale. With regard to accidents, these same drivers could be categorized accurately 65-70 per cent, primarily by their Accidents-attitude score, but also with the aid of a suppressor scale. Women drivers could be categorized only 62 per cent correctly on violations and not at all on accidents (50 per cent was chance).

In conclusion, two attitude scales were derived and cross-validated to predict reasonably well drivers with violations or accidents. Three auxiliary scales were also derived to help ensure the validity of the test results.

Microfilm $2.75; Xerox $5.80. 119 pages.

DETECTION AND RECOGNITION WITH UNCERTAINTY

(L. C. Card No. Mic 61-2065)

Elizabeth F. Shipley, Ph.D.
University of Pennsylvania, 1961

Supervisor: R. Duncan Luce

Previous experiments on detection of acoustic signal embedded in noise show detection performance is poorer when the subject is uncertain of the frequency of the signal presented on a given trial than when he knows the signal frequency. These studies suggest there are two kinds of performance in procedures with frequency uncertainty.

The first part of this thesis is a theoretical analysis of these findings which also applies to data from other experimental procedures. Choice models for forced-choice and yes-no detection tasks and for recognition tasks developed by Luce in Individual Choice Behavior (Wiley, 1959) are assumed to apply to procedures with uncertainty. In detection, uncertainty means the subject does not know some aspect of the signal such as which one of several possible frequencies is employed on a given trial; in recognition, uncertainty means the subject does not know either which temporal interval contains a signal (forced-choice presentation) or whether or not a signal was presented (yes-no presentation).

Composite choice models are written for procedures in which both detection and recognition are required. Covert responses are assumed in procedures with uncertainty even when recognition (or detection) is not required overtly. This assumption permits the equation of composite models and simple models in procedures with uncertainty. By this equation, parameters in procedures with uncertainty are related to those from the simple detection and recognition procedures. A mathematical analysis yields constraints on possible parameter values. It is argued that two different sets of constraints (two mathematical solutions) correspond to the two qualitatively different kinds of behavior previously observed in detection tasks with frequency uncertainty.

Data is presented from three observers run in 12 experimental conditions suggested by this analysis. Acoustic signals, either 1100 cps or 500 cps, imbedded in white noise were used. The conditions are: forced-choice and yes-no detection with the signal frequency known to the subject, forced-choice and yes-no detection with uncertainty of the frequency, recognition of the two frequencies, recognition with uncertainty of the temporal location of the signal, recognition with uncertainty of the presence of the signal, and three procedures in which both recognition and detection responses were required. These latter three conditions consisted of forced-choice presentation, of yes-no presentation with recognition required on all trials and of yes-no presentation with recognition required only when a "yes" detection response is made.

The data clearly support the covert response assumption for procedures with uncertainty. They suggest the relation originally assumed for parameters from forced-choice and from yes-no detection tasks is inadequate. Arguments are presented for an alternative relation which is equally plausible and which appears to account for the data. Finally, the results indicate the inadequacy of the original models written for tasks where both detection and recognition are required. Revised models are presented for these procedures. In these models the subject is assumed to make his decisions in stages, first recognition and then detection. The data are judged a good fit to these two-stage decision models.

Microfilm $2.75; Xerox $4.60. 88 pages.

THE MEASUREMENT OF RISK-TAKING PROPENSITY IN AN INDUSTRIAL SETTING

(L. C. Card No. Mic 61-1810)

Lawrence Kenneth Williams, Ph.D.
University of Michigan, 1961

The major purpose of this study was the development of a scale using forced choice alternatives that would differentiate members of an industrial population in terms of their propensity to take risk as against the seeking of security. In exploring the use of the scale, an attempt was made to relate risk taking to satisfaction and attitudes

toward promotional opportunities, wages, changing conditions of the job structure, as well as to certain non-attitudinal criteria such as ability to manage change, and position in the organization.

These data were taken from a study which was conducted in a large light and power company in the Midwest. The study was designed to investigate the effects of the installation of electronic data processing equipment upon white collar workers and their work situation. Five hundred and ninety-nine Accounting employees, their 57 supervisors and 18 managers were included in the study along with a sample of 399 members of the Sales Division. The items making up the risk-taking scale were included in a series of questionnaires that were administered to these populations. The subject matter of these questionnaires dealt with satisfaction concerning job, the work group, and supervision, along with perceptions of the company, its operations, and the change-over to electronic data processing equipment. Items from these questionnaires as well as behavioral observations, a job analysis form, and ratings of supervisory effectiveness were used to provide criterion measures.

Using Guttman scaling procedures an eight-item scale measuring risk-taking propensity was developed. This met generally accepted scaling standards. The "reproducibility coefficient" for two independent samples of 100 was .89 and .91.

Seven of the nine hypotheses were confirmed. Two hypotheses were partially confirmed. It was found that high risk takers, in contrast to low risk takers, placed more emphasis on promotions and doing things they were best at and less on getting along well with other people and on employment security. The high risk taker also preferred ability and merit as criteria for mobility in the organization and had more confidence than did the low risk taker in his ability to find jobs outside the organization when these needs were not met. There was a low positive correlation between risk taking as measured by the developed instrument and need for independence.

It was also found that individuals who were high risk takers had a greater tolerance for change in an organization and that they performed better than did low risk takers under changing conditions in the organization. With respect to the amount of risk inherent in the job, it was found that individuals disliked their jobs when the jobs provided less challenge in terms of risk than the individuals were willing to take.

Finally, it was established that organizational positions can be identified in terms of the amount of risk taking that is required for successful performance.

Microfilm $2.75; Xerox $5.40. 108 pages.

PSYCHOLOGY, CLINICAL

THE EFFECTS OF INDUCED ANXIETY ON THE INCIDENTAL LEARNING OF HIGH AND LOW ANXIOUS SUBJECTS

(L. C. Card No. Mic 61-2028)

James Francis Duffy, Ph.D.
University of Pennsylvania, 1961

Supervisor: James C. Diggory, Ph.D.

Statement of Problem:

Many studies relating anxiety and learning have been primarily concerned with some questions of learning theory and the interest in anxiety has been secondary. However, these studies are useful in understanding anxiety and the relationship of anxiety and incidental learning would seem to offer opportunity for further investigating the concept of anxiety.

It is assumed that subjects react to an anxiety producing situation by increasing their attention both to matters of the self and to the assigned relevant task. If subjects direct their attention in this manner, the incidental aspects of the experimental situation will be relatively ignored and there will be a decrease in incidental learning when the situation is threatening. Since the high anxious subjects have a greater "potential" for anxiety when threatened, it is assumed they should direct greater attention to the self than low anxious subjects and consequently learn less incidental material.

Procedures and Methods:

An attempt was made to induce anxiety by ego-instructions and by confronting the subjects with a difficult relevant task. High and low anxious subjects were selected from the extremes of the Taylor Anxiety Scale. The relevant task consisted of line discriminations, one group receiving relatively "easy" discriminations and the other, "difficult" discriminations. The incidental material consisted of twelve cities which were repeated on a tape recorder while the subjects performed the relevant task. The subjects were told the list of cities and accompanying taped conversation were to serve as a distraction. Recall and recognition scores for the incidental material were obtained.

Results:

The results showed the anxiety variable to be significant in the analysis of both recall and recognition scores. The instruction variable was significant in the analysis of the recall data only and the variable of relevant task difficulty was not significant in either analysis.

Conclusion:

Thus, the high anxious subjects learned less of the incidental material than the low anxious subjects. This result was predicted by assuming that under threat the high anxious group direct more attention to the self. This concept is similar to the concept of irrelevant responses to anxiety advanced by Mandler and Sarason. Many experiments relating anxiety and learning have employed the Hullian concept of "drive" and assumed that the high anxious subjects are characterized by a high drive level. Anxiety, as a concept, should probably include both drive and irrelevant responses as characteristics.

The ego-instructions had a negative effect on incidental learning. The effect of induced anxiety, as by ego-instructions, will be the same for high anxious subjects in relevant and incidental learning situations. However, it is assumed that low anxious subjects will learn relevant material better under ego-instructions and incidental material less well.

Since there was a significant difference between the anxiety groups under conditions of no threat (standard instructions and easy relevant task), perhaps threat is not necessary to manifest differences between these groups. However, observation suggests that to some subjects the experimental procedure, in itself, elicited anxiety. This observation raises the question of the degree to which threat may be present in experiments with "standard" instructions. Microfilm $2.75; Xerox $3.00. 44 pages.

THE EFFECTS OF SUBLIMINAL STIMULI OF AGGRESSIVE CONTENT UPON CONSCIOUS COGNITION

(L. C. Card No. Mic 61-737)

Morris N. Eagle, Ph.D.
New York University, 1958

Adviser: Dr. George S. Klein

The experiment is concerned with the general issue of registration of information without awareness and its effects upon cognitive activity.

To investigate these problems, use was made of a technique which permits study of subliminal registrations through their effects upon impressions of a consciously perceived stimulus: Expose in quick succession a pair of stimuli at the same point on the screen of a mirror tachistoscope. If the second (B-stimulus) follows the first (A-stimulus) in sufficiently rapid succession and in a sufficiently longer exposure, only the second of the pair is consciously seen.

In the present experiment, there were two A-stimuli: one, a boy in an aggressive action; the other, in a benevolent action. The B-stimulus was the same boy in the above two actions, but alone and in a neutral position. The A-stimuli were paired with the "masking" B-figure in a balanced design.

The modes of response to the B-figure were: 1) Free description of B-figure; 2) Rating of B-figure on Trait list; 3) Drawing of B-figure. Two experimental sessions were devoted to pairing the A and B-stimuli and obtaining S's impressions of the latter. In a third experimental session, ascending recognition threshholds for the A-stimuli were obtained under "masking" conditions. Both the Ss' reports and the threshhold data indicated that the A-stimuli were not in the S's awareness.

Results

The major issue was whether the subliminal aggressive and non-aggressive stimuli differentially affected impressions of the B-figure. The free descriptions yielded few clear-cut results. The Trait list ratings and drawings of the B-figure produced significant results: On the former, the Ss tended to attribute more negative traits under the aggressive than under the non-aggressive condition. The drawings of the B-figure showed greater aggressiveness when preceded by the aggressive A-stimulus.

The over-all results were interpreted to support the formulation of registration and perception as independent processes in which material can register without implicating awareness and nevertheless exert influences upon cognitive activity.

The only significant relationships between threshholds and responsiveness to the A-stimuli involved the male Ss and the aggressive A-stimulus. The direction of the relationship indicated that beyond a certain minimal exposure, the further below the level of conscious recognition the A-stimulus was, the greater its effects upon impressions of the B-figure. This finding is contrary to partial information implications. It seemed rather to support the psychoanalytic notion that when stimulation is accompanied by low-attention cathexis, its mobility and "recruitability" are facilitated.

It was felt that registration without awareness was effected by mobilization of S's attention. It was hypothesized that the A-stimuli did not attain perceptual status because, by virtue of the experimental arrangement, attention was "diverted" from them and to the B-figure. This diversion of attention permitted exposure levels that were adequate for registration, and that would have been adequate for conscious perception of the A-stimuli if they had been receiving attention.

The nature of the interaction between A and B-stimuli was formulated as follows: A-stimuli cues which register activate cue-relevant schema which, in turn, act to strengthen those hypotheses or sets concordant with the schema activated. The strengthened hypotheses, in turn, serve to increase the probability of appearance of set-relevant responses.

Microfilm $2.75; Xerox $5.00. 99 pages.

THE CONDITIONING OF NEUROTIC VERBALIZATIONS

(L. C. Card No. Mic 60-6177)

Louis Everstine, Ph.D.
University of Pittsburgh, 1960

This research examined the subject of the conditioning of neurotic verbalizations in a sample selected from a college student population.

Verbalizations conditioned in this experiment were based on materials chosen by means of ratings by judges. Fifty pairs of phrases (sentence predicates) were constructed; each pair contained one phrase rated "intensely neurotic" and one phrase rated "neutral." A completion-of-sentences task was utilized, in which subjects were presented a pair of phrases, instructed to use one of the two phrases to complete a sentence, and say the sentence aloud. Free choice among five pronouns for use as sentence subjects was given. Following each sentence verbalized, reinforcement for the phrase chosen was presented by the experimenter; a correction-of-errors method was utilized. Ten non-reinforced trials were presented, followed by forty reinforced trials. Subsequent to conditioning, subjects were administered the Maudsley Personality Inventory;

subjects were then questioned about the experiment in a brief, standardized interview.

Eighty subjects (40 males, 40 females) participated in the experiment. On the basis of their quartile scores on a previous administration of the Maudsley Neuroticism Scale, subjects were assigned to four groups. Half the subjects in each group were reinforced for verbalizations of neurotic phrases; half were reinforced for verbalizations of non-neurotic phrases.

The principal results of the experiment are summarized below. The college student subjects were trained to discriminate between neurotic and non-neurotic verbal stimuli. They were trained to make verbalizations based on neurotic stimuli with greater frequency than they made neurotic verbalizations prior to training. They were trained more rapidly to make neurotic verbalizations than non-neurotic verbalizations. The total amount of learning of non-neurotic verbalizations was greater than the total amount of learning of neurotic verbalizations.

Subjects who were aware of the content or connotations of the verbal stimuli presented learned faster in the verbal conditioning task than did subjects who were not aware, whether they were trained to make either neurotic or non-neurotic verbalizations.

Subjects whose scores were at either of the extremes in a distribution of Neuroticism test scores learned faster than did subjects whose scores were nearer the median of that distribution, whether they were trained to make either neurotic or non-neurotic verbalizations. Subjects whose scores were in the highest quartile on the test of Neuroticism learned faster when trained to make neurotic verbalizations than when trained to make non-neurotic verbalizations; the same result was found in the case of subjects whose scores were in the lowest quartile on the test of Neuroticism.

The scores of subjects who were trained to make neurotic verbalizations increased only minimally on two administrations of the test of Neuroticism. The scores of subjects who were trained to make non-neurotic verbalizations decreased markedly on two administrations of the test of Neuroticism.

The data of this research suggested the following conclusions: (1) the verbal conditioning paradigm was extended more fully to problems of the verbalization of "emotionally charged" material; (2) awareness is related to conditioning of verbalizations in a discrimination task of the nature of the one presented in the present study, but the measurement of awareness is insufficiently refined at this time; (3) relative position in a distribution of performances on a self-report test of Neuroticism is related to rate of learning in a verbal conditioning task involving materials similar to those contained in the test; and, (4) tentatively, scores on a self-report test of Neuroticism are modifiable through the medium of the conditioning of non-neurotic verbalizations--which, in turn, suggests the existence of a limited relationship between verbal conditioning and certain of the processes of psychotherapy.

Microfilm $2.75; Xerox $7.60. 165 pages.

THE EFFECT OF LENGTH OF FOOD AND WATER DEPRIVATION AND SCHEDULE OF NOXIOUS STIMULATION UPON PRODUCTION OF ULCERS IN THE RAT

(L. C. Card No. Mic 61-1282)

Donald R. Farren, Ph.D.
The Florida State University, 1961

The present experiment was undertaken to specify the roles of electric shock, food and water deprivation, and a discriminative stimulus (S^D), a light preceding the shock, in the production of ulcers in the rat. The issues raised were as follows:

1. Will shock alone lead to ulcers?
2. What is the effect of different lengths of deprivation?
3. What is the effect of different schedules of shock and S^D?
4. What is the role of an S^D?

There were four lengths of deprivation: 0, 20, 44, and 68 hours. There were four shock-S^D schedules: shock continuously preceded by a light, shock randomly preceded by a light, shock randomly with no light, and shock alternately preceded by a light half of the time. There were eight control groups which were exposed to the four deprivation conditions, half of which lived in experimental cages and half lived in home cages. There were eight animals per group.

The experimental cages were individual cages which had an aluminum ceiling acting as one electrode. The rest of the cage acted as the second electrode. The animal's body acted as a conductor, and the shock was sufficiently high to arc to the animal even if he were not touching both electrodes. Shock was presented for two seconds, and all animals received 20 shocks per hour. The time between shocks was similar for all groups, varying from four seconds to fifteen minutes.

At the end of the deprivation periods, animals were allowed free access to food and water for four hours. If animals had not died within 21 days, they were sacrificed. The stomachs were examined microscopically to determine the presence of ulcers.

The 68 hour deprivation groups were not all run because all control animals living in the experimental cages and three of the animals living in home cages died and had ulcers. No other control animals had ulcers. Only one of the 32 animals that were shocked but had ad libitum food and water showed ulcers. All of the shocked and deprived animals, except two (78 out of 80) had ulcers.

An analysis of variance of number of days to die for the 20 and 44 hour deprivation groups was significant for both the deprivation and S^D schedule variances.

Conclusions of the study are as follows:

1. Shock, by itself, does not lead to ulcers, at least within the 21 day time limit used in this study.
2. Food and water deprivation, by themselves do not lead to ulcers unless deprivation is extremely long (at least 68 hours) and is combined with partial restriction of movement.
3. Deprivation and shock, in combination, produce more ulcers than do either conditions alone.

4. The length of deprivation has no effect on whether or not animals develop ulcers, but it does affect the time it takes the animals to die. The longer the deprivation periods is, the quicker is death.

5. The type of schedule of S^D and shock has no effect on the occurrence of ulcers, but it does affect the time to die. Animals who are shocked on a random or no S^D schedule die sooner than do animals on continuous or alternate S^D schedule. The role of an S^D seems to be one of warning the animals that noxious stimulation is coming, making it easier for animals to adapt themselves to the shock.

Microfilm $2.75; Xerox $3.00. 31 pages.

A STUDY OF THE VOCATIONAL INTERESTS OF FOUR TYPES OF PSYCHOTIC SUBJECTS

(L. C. Card No. Mic 60-6433)

Stephen Jon Golburgh, Ed.D.
Boston University School of Education, 1960

Problem

This was a study to investigate the vocational interests of four types of psychotic subjects to determine if they differ significantly from a normative group of nonpsychotic subjects and from each other. The study was concerned with the relationship between inventoried vocational interests and the variables of age, education, length of present hospitalization, total number of hospitalizations, total length of hospitalizations, occupational level, and intelligence.

Scope

This study included 120 hospitalized psychiatric patients, 30 in each of four subgroups. These were: (1) schizophrenic reaction, catatonic type; (2) schizophrenic reaction, paranoid type; (3) schizophrenic reaction, schizo-affective type; and (4) manic depressive reaction, depressed type.

All subjects were in essentially normal physical health, were between the ages of 16 and 60, and were patients at one of two Massachusetts State Mental Hospitals.

Procedure

Inventoried interests were investigated by means of the Kuder Preference Record--Vocational, Form CH. Future vocational plans were determined by the interview method. Intelligence was evaluated by the Kent Intelligence Scale. Patients were examined individually when their psychoses were in remission. Occupational level was classified on the basis of a six-point scale.[1] The remaining variables were determined from the hospital records.

Major Findings and Conclusions

1. There was a strong tendency for the psychotic groups to score differently from the normative group in the areas measured by the Kuder Preference Record.

2. For the total psychotic group, when compared to the normative group, the means for the outdoor, mechanical, scientific, and computational scales were significantly lower and the means for the musical, literary, and social service scales were significantly higher.

3. For the catatonic subgroup, when compared to the normative group, the mean for the musical scale was significantly higher and the mean for the mechanical scale was significantly lower.

4. For the depressed subgroup, when compared to the normative group, the means for the outdoor, mechanical, and scientific scales were significantly lower and the means for the musical, literary, and social service scales were significantly higher.

5. For the paranoid subgroup, when compared to the normative group, the mean score on the literary scale was significantly higher and the mean score on the mechanical scale was significantly lower.

6. For the schizo-affective subgroup, when compared to the normative group, the mean scores on the musical and literary scales were significantly higher and the mean score on the mechanical scale was significantly lower.

7. The psychotic patients generally scored within normal limits on the verification scale of the Kuder. This tends to indicate that the results of interest inventories are useful in counseling with psychotic patients.

8. The results of the intercorrelations of the interest scales and variables showed few significant relationships.

9. The inventoried interests of the psychotic groups were found to be generally unrealistic from the point of view of the occupations that are usually available to psychiatric patients.

10. The inventoried interests of the psychotic patients were generally in disagreement with what they expressed as their future vocational plans. Inventoried interests may represent areas where greater satisfaction, self-esteem, and self-realization can be attained.

11. The future vocational plans of the psychotic patients were quite realistic in terms of the kinds of occupations that are usually available to them.

Possible Implications

There appear to be important relationships between various psychotic characteristics and the inventoried interests of psychotic groups. It seems possible to look upon interests as means or potential means of satisfying psychodynamic needs of the psychotic personality.

1. A. Roe, The Psychology of Occupations (New York: Wiley and Sons, 1956), p. 149.

Microfilm $2.75; Xerox $5.60. 113 pages.

SOME PSYCHOLOGICAL CORRELATES OF THE PROCESS-REACTIVE CONCEPT OF SCHIZOPHRENIA

(L. C. Card No. Mic 61-1699)

Nathan Ilanit, Ph.D.
University of Southern California, 1961

Chairman: Professor Klein

This study was concerned with the process-reactive concept of schizophrenia as related to degree of disturbance and prediction of outcome. In the light of conventional implications of this concept, the following six hypotheses were subjected to systematic investigation: (1) Paranoid and catatonic patients are more likely to belong to the reactive category, while hebephrenic and simple schizophrenics would more frequently fit into the process category. (2) Using the Shipley-Hartford Retreat Scale and the Similarities subtest of the WAIS as measures of abstract thinking, those in the reactive category should achieve higher scores than those in the process group. (3) Social judgment as measured by the Comprehension subtest of the WAIS should be less impaired in reactive than in process cases. (4) Difference scores between Digit Span and Arithmetic subtests of the WAIS, regarded as indicators of cognitive control, will show greater loss of such control by process schizophrenics. (5) Anxiety as measured by both the Welsh Anxiety Index and the Taylor Manifest Anxiety Scale will show a higher anxiety level in the reactive than in the process group. (6) In terms of the K scale of the MMPI, the reactive cases will be found to be more defensive than the process cases.

The subjects were 106 hospitalized schizophrenic patients, including 52 men and 54 women, ranging in age from 18 to 51 years with mean age of 29.9 years. Patients were included in the study if they had no known brain damage, had had no previous psychiatric hospital admission and had not currently been hospitalized for more than one and a half years. Three clinical psychologists applied the Wittman-Elgin Prognostic Rating Scale to the patients' social case histories. The resultant three ratings for each patient were combined into a composite distribution of ratings on the basis of which 32 subjects were selected with unfavorable prognosis, or process schizophrenia, and 36 with favorable prognosis, or reactive schizophrenia.

Results. The results showed that process patients differed significantly from reactive patients in social judgment. Process patients, contrary to the prediction, had a significantly higher level of anxiety as measured by the Welsh Anxiety Index. However, the two groups did not differ significantly, although some trends were evident in the predicted direction, in abstract thinking, attention, and concentration (or cognitive control), and in the diagnostic subclassification. In terms of tests used, the Shipley-Hartford Retreat Scale, the Arithmetic subtest of the WAIS, the Taylor Manifest Anxiety Scale, and the K scale of the MMPI all failed to differentiate between the two groups of patients.

Conclusions. The present findings do not justify more than a qualified answer to the question of relative degree of psychopathology in process as contrasted with reactive schizophrenia. Specifically, process schizophrenics manifest more psychopathology as suggested by their comparatively poorer social judgment and by their tendency to exhibit more anxiety in some situations. In reactive schizophrenia anxiety may be at an optimal level motivating change, while in process schizophrenia anxiety may be high in some situations and low in others. Consistently, anxiety may be a sign of favorable prognosis when it is not extreme, but when it is overwhelming the effect may be catastrophic.

Concerning diagnostic classification, it was concluded that previously reported contradictory findings may be explained by the fact that the diagnosis of paranoid schizophrenia embraces two types of patients, one with favorable and another with unfavorable prognosis.

It was further concluded that the objective psychological instruments used may not be sensitive enough to differentiate between process and reactive schizophrenics.

Microfilm $2.75; Xerox $5.80. 120 pages.

A STUDY OF CERTAIN PERSONAL AND SOCIAL FACTORS DIFFERENTIATING THE NONEVIDENTLY HANDICAPPED FROM THE PHYSICALLY NORMAL ADOLESCENT

(L. C. Card No. Mic 61-1834)

Jack Menzenwerth Irwin, Ph.D.
Cornell University, 1960

The present investigation tested a number of hypotheses regarding the personal and social factors differentiating the adolescent with a nonevident physical defect from the adolescent who is physically normal. A nonevident physical defect was a defect not reflected in the outward physical image.

A group of handicapped and physically normal ninth grade pupils from five public high schools in Ottawa County, Michigan were tested with four paper-and-pencil tests; their parents were asked to complete a Parent-Child Questionnaire. Criteria for judging a physical defect to be "nonevident" were established -- such defects medically classifiable as defects of the heart, bone, vision, and hearing.

First main hypothesis: Individuals who have a nonevident physical defect will be less well-adjusted than individuals who are normal. The hypothesis was confirmed (.01 level of confidence) by the Bell Adjustment Inventory and the California Test of Personality. Of eight t tests (total and subscores) only two were not statistically significant at the .05 level or better.

Second main hypothesis: Individuals who have a nonevident physical defect will perceive the class as rating them as less expressive on certain personality traits. The hypothesis was confirmed (.01 level of confidence) on the Tryon Paired-Traits Test. Traits which most sharply differentiated the groups were: popular -- unpopular, daring -- afraid, fights -- avoids fights, leader -- follower, active -- sedentary. The handicapped group was less expressive on all of these "prestige" traits for the adolescent.

Third main set of hypotheses: Individuals who have a nonevident physical defect will show (1) fewer aggressive tendencies against others, (2) more tendencies to withdraw from others, (3) fewer tendencies to approach others (altruistically), and (4) more concern about physical

complaints. Only Hypothesis 3 was confirmed (.01 level of confidence) on the Hildreth Personality and Interest Inventory.

Fourth main set of hypotheses: Parents of individuals who have a nonevident physical defect will (1) show greater child-centeredness in their relationships with their children than parents of individuals who are normal, (2) show less readiness to enforce rules in their relationships with their children than parents of normal individuals, and (3) will have less disciplinary friction in their relationships with their children than parents of normal individuals. None of the hypotheses were confirmed at the .05 level or better on a Parent-Child Questionnaire.

A number of post hoc hypotheses were formulated based upon the responses of the Handicapped Group only. Between sub-groups mean differences in adjustment (total score Bell test) were not statistically significant (.05 level of confidence) with the following variables considered: (1) admission of defect to others, (2) sex difference, and (3) type of nonevident physical defect.

Four sub-groups of the Handicapped, identified by their adjustment (high or low) and by their revealing or not revealing a defect to others, were then analyzed for their self-ratings on a triad of physically "aggressive" traits -- daring, active, fights. A speculation developed that if an individual believes that the class knows he has a defect (handicap), he would believe that the class would rate him as less daring, active, fighting than an individual who is normal; conversely, if an individual believes that the class does not know he has a defect, he would believe that the class would rate him as normally daring, active, fighting. The two sub-groups who were less well-adjusted showed exactly opposite tendencies, a finding that should instigate further research.

Microfilm $3.00; Xerox $10.60. 232 pages.

AN EXPLORATORY STUDY OF THE ROLE OF SUGGESTION IN RESEARCH ON SENSORY DEPRIVATION

(L. C. Card No. Mic 61-1752)

Charles Wesley Jackson, Jr., Ph.D.
University of Michigan, 1961

Although many investigators are studying the effects of sensory deprivation it is unclear whether the reported effects are due to some dimension of the experimental conditions per se or are due to some extent to suggestion. The over-all purpose of the present study was to explore the possible effects of suggestion upon the phenomena following sensory deprivation. More specifically, an attempt was made to determine the effects of explicit, overt suggestion upon, (a) subjective, self-report phenomena during one hour of sensory deprivation, and (b) the effects on post-deprivation test performance.

Subjects were individually administered a battery of ten objective tests. Each control subject was then given a free period of one hour, followed by re-administration of the test battery, administration of a questionnaire, and an interview. Each experimental subject was given a prepared set of expectancies regarding the effects of sensory deprivation upon subjective, self-report experiences and upon post-deprivation test performance. In order to create relatively strong expectations, experimental subjects were also told that they would take the drug, "Sernyl," which produced the same effects as sensory deprivation.

Experimental subjects were then each administered two placebo pills and placed in a typical sensory deprivation situation for one hour. All verbalizations during the hour were recorded. Following deprivation the test battery was re-administered, a questionnaire was given, and the subject was interviewed.

The subjects were volunteer, male college and graduate students, and were paid five dollars for approximately four to five hours time. Test data were obtained for eleven control and eleven experimental subjects. Subjective, self-report experiences were obtained for three additional experimental subjects.

It was found that these experimental conditions elicited many varied self-report phenomena including: visual, auditory, taste, smell, somesthetic, emotional, and cognitive experiences. The reality of these experiences and subjects' reported ability to control these experiences varied considerably.

Although there were a number of pre-post changes in test performance, none of these changes could be attributed to the influence of explicit, overt suggestion. Analysis of the questionnaire data showed that when the naive control subjects predicted the effects of sensory deprivation (and Sernyl) on test performance, they generally agreed with each other; furthermore, their predictions generally were the same as what the experimenter would have hypothesized in a typical sensory deprivation experiment.

Our findings support the conclusion that explicit, overt suggestion in the context of a sensory deprivation situation does produce a wide array of subjective, self-report phenomena, but does not significantly influence post-deprivation test performance. This does not rule out the possibility that other more subtle forms of suggestion might influence test performance.

The subjective, self-report phenomena were compared to those reported in other studies of much longer periods of sensory deprivation, and it was concluded that the experiences primarily due to suggestion are very similar to those reported as due to some dimension of the experimental conditions per se. Therefore, it is necessary to question seriously the previous explanations of self-reported phenomena based primarily on dimensions of the experimental conditions per se. Proponents of these earlier explanations should now be prepared to demonstrate that their experimental results are due to some dimension of the experimental conditions rather than being due to suggestion. In addition, it is also necessary to question the common assumption that sensory deprivation phenomena and schizophrenic phenomena have similar causes. Microfilm $2.75; Xerox $7.80. 166 pages.

BINAURAL BEATS: THEIR PERCEPTION BY INDIVIDUALS WITH AND WITHOUT ORGANIC BRAIN PATHOLOGY.

(L. C. Card No. Mic 61-1286)

Eric G. Kent, Ph.D.
The Florida State University, 1961

The binaural beat phenomenon is considered by some hearing theorists to be mediated by the central nervous system. On the possibility that damage to the brain might disrupt the perception of beats, their application in an auditory test for brain damage was explored.

Twenty-six Veterans Administration patients, ranging from 21 through 69 years, with medically established diagnoses of chronic brain syndrome were matched for age with 30 persons having no known history of brain injury. All had been audiometrically screened to eliminate those with defective hearing.

Paired audio-oscillators were used to present four test series to each subject, consisting of combinations of a fixed 57 decibel, 250 cycles per second signal to one ear, and a slowly ascending or descending 200 to 300 cycles per second signal to the other. A continual verbal report was encouraged. Following the test series, the possibility of having heard but not having reported beats was checked. The Graham-Kendall Memory-for-Designs Test was then administered.

Two separate definitions of beats were considered. Seventy-seven per cent of the non-brain damaged subjects were able to describe the equivalent of oscillations, surges, or pulsations, while 88% of the brain damaged group were unable to experience this perception. This revealed slightly greater sensitivity than the Graham-Kendall test which diagnosed 77% of those with brain damage. The second definition which also included the aspect of roughness, did not enhance the test's ability to discriminate organics from normals.

Frequency, range and the influence of age revealed no significant differences with the exception that brain damaged subjects reported hearing beats defined as roughness over a wider frequency.

It was concluded that the ability to perceive binaural beats provided the basis for a valid test for intracranial organic pathology which was characterized by brevity, simplicity of administration, ease in scoring, minimization of distractibility and reduction of any sense of failure. It should have a unique potential for testing persons with blindness or neuromuscular impairment.

Microfilm $2.75; Xerox $3.00. 36 pages.

FANTASY MEASURES OF AGGRESSIVE BEHAVIOR

(L. C. Card No. Mic 61-1763)

John Neil Marquis, Ph.D.
University of Michigan, 1961

The purpose of this study is to hypothesize meanings for several variables coded from the Thematic Apperception Test (TAT) and correlate them with ratings of many aggressive behaviors in order to confirm or modify the hypotheses. Previous studies of fantasy variables have ascribed to them meanings which are too complex to be tested against their simple criteria of aggressive behavior. Meanings are hypothesized for eight primary TAT variables and four combined indices, and from these hypotheses the behavioral correlates of each variable are predicted.

Subjects are sixty-four boys ranging from eight to fifteen years of age. All were disturbed children attending the University of Michigan Fresh Air Camp. They represent an extremely aggressive group with severely traumatic backgrounds. Stories told in response to ten TAT cards were scored for the twelve variables. Counselors, schools, parents, and referring agencies rated fifty-six behaviors and traits which theoretically reflect ways in which the child expresses aggression. A pearsonian intercorrelation matrix including both independent and dependent variables was computed.

On the basis of the number of behavioral correlates of each TAT variable, the intercorrelations of TAT variables, and the relative independence of scoring procedures, seven TAT variables are felt not to warrant discussion. Similarly, thirty-five behavioral ratings are eliminated because they failed to show more significant correlations with TAT variables than would be expected by chance.

The TAT variable most strongly related to behavior is Resistance (subject tells a guarded story or resists task). Its behavioral correlates reflect open aggression, denial or guilt, and an absence of constructive behaviors; and it correlates negatively with other TAT variables. It is interpreted as reflecting resistance to attempts to elicit cooperation or change. Aggression-out (hero aggresses, or villain is punished) relates positively to constructive behaviors and negatively to aggression. This contradicts previous findings with similar measures. It is suggested that the communication of hostile content is in itself evidence of cooperation in this resistive sample. Aggression-in (self-injury, remorse, depression) is unrelated to aggressive behavior, but relates to measures of weakness and passivity. The perception of Nurturance from Parents correlates positively with constructive behaviors and negatively with aggressive behaviors, and is interpreted as reflecting positive interpersonal relationships.

The relative failure of other TAT variables, including failure to replicate previous findings, is discussed in terms of three factors. First, most members of the sample resist telling stories to such an extent that the content variables serve as measures of cooperativeness. Second, the use of cards depicting adults to elicit fantasy material from children leads to a lack of ego involvement and identification with story characters, and the meanings of TAT variables may change under these conditions. Third, correlating the TAT measures with a large number of dependent variables leaves less freedom for speculation as to the reasons why a particular TAT variable relates to aggressive behavior than when a single criterion measure is used.

It is concluded that less is known about the relationship between fantasy and aggressive behavior than is generally recognized. The meanings of fantasy variables depend strongly upon the population studied, the pictures used, the interaction between population and pictures, and many other factors which have not been adequately studied. A more measurement-oriented and molecular approach to future research in this chaotic area is indicated.

A method for refining Resistance is proposed and the possibility of relating this variable to measures of therapeutic movement is considered.

Microfilm $2.75; Xerox $6.80. 143 pages.

PERSONALITY CORRELATES OF THE PLACEBO REACTION

(L. C. Card No. Mic 61-1411)

Bruce Paul Muller, Ph.D.
Columbia University, 1961

Placebos have been shown to provide up to 75 per cent relief in a variety of pathological conditions, and to produce objective effects equal to, or greater than, those produced by potent "active" drugs. Clinical and experimental studies have suggested the existence of a "placebo reactor" type, with a personality characterized by anxiety, depression, and acquiescence, who will consistently react to placebos in almost any situation. The purpose of the present study was to investigate, under rigorous experimental conditions, the personality correlates of placebo reaction, and to determine the consistency of individual reactions to placebos.

Subjects were 40 normal, healthy, male, paid volunteer college students, who were told that they were participating in an investigation to determine the effects of certain combinations of chemical agents upon psychological test performance. Following an initial session to acquaint subjects with test procedures, subjects reported for six successive days and ingested chemical agents in the following order: Day 1, placebo; Days 2 through 5, varied dosages of two "active" drugs, used as reference standards; Day 6, placebo.

The following measures were administered each day prior to ingestion of the various agents, and again 75 minutes after ingestion: flicker fusion threshold, tapping speed, choice reaction time, a simple and complex Purdue Pegboard assembly task, a scaled questionnaire of subjective feelings. At the close of each session, subjects also made a simple "yes-no" subjective judgment (SYR) of effect. Pre-post changes on the test battery, and SYR constituted measures of placebo effect. Personality characteristics of anxiety, depression, and acquiescence were measured, respectively, by the Pt and D scales of the MMPI, and by a test of acquiescing response set involving acceptance or rejection of each of 50 Rorschach card interpretations. The entire study was conducted under rigorous double-blind conditions, with all chemical agents given in identical pill form.

Analysis of results revealed that both placebos produced objective and subjective effects equal to, or greater than, effects produced by the "active" drugs. Essentially no relationship between personality scores and placebo effects was found. The only placebo effect which remained consistent for both placebo administrations was SYR.

The marked incidence of placebo reaction among normal subjects in an experimental setting indicates that the placebo reaction, far from being a medical curiosity, represents a common form of behavior. However, the data failed to support the theory of a "placebo reactor" type with personality correlates of anxiety, depression and acquiescence. Further analysis, using MMPI profile patterns rather than single scores, does suggest certain personality differences between subjects reporting drug and placebo effects and subjects denying such effects. It is also suggested that expectancies created by the situation in which a person receives a placebo may determine the occurrence of placebo reactions.

Microfilm $2.75; Xerox $4.00. 75 pages.

STEREOTYPY AND THE ROLE REPERTORY TEST

(L. C. Card No. Mic 61-1371)

George Everett North, Ph.D.
The University of Texas, 1961

Supervisor: Dr. Austin E. Grigg

The Role Repertory Test has been used for operational definitions of some of George Kelly's theoretical terms in his personal construct theory. Several Role Repertory Test measures have been asserted to reflect stereotyped thinking. The present study has examined the validity of these Role Rep Test measures of stereotyping by correlating Role Rep scores with criterion measures. For this purpose, the Role Repertory Test and criterion measures were administered to 95 college freshmen.

Categorical stereotypy refers to the treatment of all members of a class as alike. With the Role Rep Test, categorical stereotypy for a particular class was measured by finding the degree of matching between the patterns of the individual members of a class and a column pattern representative of the class as a whole. When the individuals within a given class were all similar to the class pattern, the S was considered stereotyped for that class. Two criterion measures of this type of stereotypy were used. When Ss rated two members of a class with a long adjective check list (ACL), those who tended most to use the same words for both targets were regarded as most categorical; and when Ss rated several class members with semantic differential scales, those whose ratings varied least were considered most categorical for that class. The Role Repertory Test measures of stereotypy for two classes, authority persons and opposite sex persons, were tested with each of these criterion measures.

Group stereotypy is the tendency of a S to adhere to his group's notion of a particular class of people. A Role Rep Test index of this type of stereotypy was determined by comparing each individual's modal (or characteristic) column pattern for a class, with a column pattern most representative of the group's view of the class. The criterion measure in this case was the number of popular (most frequently used) words in the ACL selected by all Ss when describing class members. Measures for both authority persons and opposite sex persons were examined.

Cognitive simplicity is a measure reflecting a lack of differentiation among constructs. In the Role Rep Test, the total matches of every row (construct) pattern with every other row is the index used. Cognitive simplicity has been proposed as an index of general stereotypy, or stereotyped thinking without regard to any particular class of persons. Study was made of the relationship of this

measure to the number of categories Ss used in sorting a group of words, and to the Dogmatism (D), Ethnocentrism (E), and Authoritarianism (F) scales.

Results:

1. Categorical stereotyping as measured by Kelly's Role Rep Test was not related to criterion measures for this type of thinking.
2. Group stereotypy as measured by the Role Rep Test was not related to the criterion measures for this type of thinking. Group Stereotypes for authority figures did not occur with Role Rep Test data, although group stereotypes for opposite sex persons did occur on the test. Group stereotypes were reflected by the criterion measure.
3. Cognitive simplicity as measured by the Role Rep Test was not consistently and significantly related to the criterion measures. A small correlation between Role Rep cognitive simplicity and a word sorting task was interpreted to reflect a tendency to leave voids in the Role Rep Test grids. Rope Rep correlations with the D, E, and F scales approached significance in female Ss, but were of zero order for male Ss.
4. In regard to the generality of stereotypy, categoricalness for authority persons and for opposite sex persons was related for the criterion scores. Also, SD measure of categoricalness and the ACL measure of group stereotypy were related. These relationships, however, were interpreted as related to a response set, variability when using rating forms.

Microfilm $2.75; Xerox $4.80. 92 pages.

THE PICTURE ARRANGEMENT TEST AS RELATED TO OCCUPATIONAL CHOICE AND VALUES

(L. C. Card No. Mic 61-1897)

Kenton Donese Pate, Ph.D.
University of Houston, 1961

The primary purpose of the present study was to evaluate the Tomkins-Horn Picture Arrangement Test (PAT), a semi-structured projective testing technique, as a means of determining motives related to occupational membership. An occupational values indicator which yields measures of values oriented in an occupational frame of reference was also used to determine the value orientations of the different occupational groupings and subgroups. Finally, the normative sample of the PAT and the present study sample were compared on the major variables of the PAT to assess the representativeness of the study sample.

A total of 120 subjects were used in the study, divided equally among five student groups. Three of the groups were composed of university students enrolled in professional curricula and two groups were composed of students enrolled in subprofessional training programs. The major fields in the professional grouping were those of management, engineering and accounting. The major fields in the subprofessional grouping were those of electronics and accounting. Only students who had indicated plans to enter employment directly related to their major fields of training were used in the study.

The most significant findings with the Picture Arrangement Test were those obtained in comparisons of the professional and subprofessional groupings on the major variables of the test. The results revealed differences between the occupational groupings on 17 out of 34 variables. There were reliable differences on conformity, social and interpersonal orientations, optimism, levels of psychological functioning, and work orientations. Eight variables were found to be reliable in comparing the professional subgroups and three variables discriminated between the subprofessional subgroups.

Two of the four variables derived from the Occupational Values Indicator (OVI) consistently discriminated between the professional and subprofessional groupings and between subgroups within these major groupings. The results were described in terms of intrinsic (career satisfaction) and extrinsic (security) work-value orientations found to be associated with occupational membership.

No significant relationships were found between motives as measured by the PAT and values as measured by the OVI, but tentative descriptions of the different occupational groupings and subgroups were presented on the basis of the significant and trend differences independently obtained with the Picture Arrangement Test and the Occupational Values Indicator.

Significant differences between the normative sample of the PAT and the study sample were obtained on 17 out of the 34 variables. Eleven of these variables were the same as those that discriminated between the professional and subprofessional groupings. There was no way of determining the degree to which the significant and trend differences obtained between the professional and subprofessional groupings represented real differences in occupational membership or sampling bias.

Microfilm $2.75; Xerox $7.00. 150 pages.

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN THE INABILITY OF SOME WOMEN IN PSYCHOTHERAPY TO ACCEPT THEIR FEMALE ROLE AND THEIR PERCEPTION OF THEIR MOTHERS' ATTITUDES TOWARD THE FEMALE ROLE

(L. C. Card No. Mic 61-345)

Alice Peters, Ph.D.
New York University, 1960

Chairman: Professor Dan Dodson

The purpose of this study was to explore possible relationships between the maladjustment of selected women to their female role and their conscious and unconscious perception of the following six categories.

1. The female role
2. Self as female
3. Their mothers' female role
4. Relationship to, and identification with mother
5. Relationship to, and identification with father
6. Relationship between the parents.

The sample population: was twelve women in psychotherapy, ages 21-41; three were married, nine unmarried.

All were first or second generation Americans of Jewish, Italian and Negro descent.

Hypotheses

There is a positive relationship between subjects' conscious and unconscious perception of the female role and their perception of their mothers' attitudes toward the female role.

There is a negative relationship between subjects' conscious perception of self and mother and subjects' unconscious perception of self and mother.

There is no significant relationship between subjects' perception of the female role and: Their relationship to, and identification with father or mother; Their perception of the relationship between the parents.

Unexpectedly the emergent data necessitated the extension of the study and the following additions:

There is no significant relationship between subjects' perception of the female role and subjects' perception of self as female.

There is a negative relationship between subjects' conscious and unconscious perceptions in all the categories.

Hypotheses were tested with a questionnaire to tap conscious perceptions; the Thematic Apperception Test to tap unconscious perceptions. Individual case studies were utilized for additional pertinent data.

Results

One of the outstanding findings of this study was that there is a significant difference between subjects' perceptions of the female role per se, which the majority rejected consciously, and subjects' perception of the female role, which the majority rejected unconsciously.

This rejection seems to be closely tied in with their conscious and unconscious perception of mother's rejection of her female role. This is the only category where there is a significant congruence between conscious and unconscious perception. In all other categories there is a significant dichotomy between these two levels. There is no congruence between subjects' conscious and unconscious perception of the relationship and identification with father. Subjects' conscious rejection of the female role and unconscious rejection of self as female is independent of their conscious and unconscious perception of: Relationship and identification with father and/or mother; Perception of relationship between the parents.

Implications in this study are that perception is one of the major keys to the understanding of personality. Unconscious perception of mother seems to be decisive in the individual's adjustment to the female role in her society.

Socio-cultural discontinuity--even if resulting in change for the better--may be one of the major causes in the etiology of women's maladjustment to their role.

Conscious and unconscious perception of mother's rejection of her female role seem to be incorporated in some women's unconscious rejection of the female role for themselves. The female role per se seems to be perceived as an abstract concept--as such less dangerous--and thus, can be rejected consciously.

Identification with either parent does not seem to play any decisive role in the psycho-sexual maladjustment of the discussed women.

This study has indicated the direction in which more research is needed to investigate women's inability to accept their sex role. In addition, it may be fruitful to investigate the isolation of the discussed problems from any nosological classification of maladjusted women.

Microfilm $3.60; Xerox $12.60. 277 pages.

AN ANALYSIS OF PRESURGICAL ANXIETY IN BOYS AND GIRLS

(L. C. Card No. Mic 60-6932)

Shirley Chichester Sims Schneider, Ph.D.
University of Michigan, 1960

This study was concerned with the nature of fears and fantasies of children about to undergo surgery, with particular reference to differences that may exist between boys and girls in the level and type of preoperative fears. The previous research on this problem showed that surgery arouses the great fears of childhood—separation anxiety and castration anxiety—and that very young children are more profoundly affected by separation while older children tend to fear mutilation. The psychoanalytic theory of anxiety and the typical "danger situations" of childhood were reviewed, as was the psychoanalytic theory of the different course of the Oedipus complex in boys and girls. The hypotheses were made that the preoperative castration anxiety reactions of boys and girls would be different, that castration anxiety would be greater in hospital children than in school children, and that castration anxiety would be greater in boys.

Forty-six children between the ages of six and nine were interviewed and examined shortly after their admission to the hospital for a tonsillectomy. Fifty school children similar with respect to age, sex, race, and socio-economic class were examined with the same techniques. The techniques utilized were projective story-telling tests, the Michigan Picture Test, and a specially constructed test, human figure drawings, and a partly structured interview in which dream material and the children's verbalized feelings about surgery were sought.

Problems were encountered in the measurement of anxiety. It was found that a good measure of the level or quantity of anxiety could not be based on the frequency with which anxious content appeared in their stories, because the type of defense affected profoundly the extent to which anxiety was expressed on the projective tests. A "Castration Anxiety Measure" was developed, which scored manifestations of castration anxiety as derived from psychoanalytic theory. Fears of death, guilt feelings, and fears of loss-of-love were also investigated.

The findings indicated that children about to undergo surgery were rated as more anxious and less well defended than were comparable school children. The dreams of the hospital children were more catastrophic than those of school children. Their projective test records showed more blocking and other indications of heightened defensiveness, and also more guilt reactions.

Some differences were found between boys and girls in their preoperative anxiety. Castration anxiety was a common phenomenon in both groups of boys, and any quantitative change in the level of this type of anxiety was not reflected in the frequency of expression on the projective tests. Evidence was found for blocking and immobilization

in the boys. The projective tests of the hospital girls showed the arousal of anxieties that are under ordinary circumstances infrequently expressed. Girls showed an increase in castration anxiety, and the striking appearance of fears of death, which were interpreted as relating to the fear of separation and loss-of-love. The findings suggested that, contrary to the original hypothesis, girls showed a relatively more marked arousal of fears, and a more regressive character to the fears that were aroused. Microfilm $2.75; Xerox $6.20. 126 pages.

SELF CONCEPT FACTORS AFFECTING JUDGMENTS OF OTHERS

(L. C. Card No. Mic 61-1077)

Fred Donald Strider, Ph.D.
The University of Nebraska, 1961

Adviser: Marshall R. Jones

The purpose of this study was to devise an adequate instrument for measurement of self concept variables related to inaccuracies and defensiveness in judgments of others and to test a differential prediction derived from the personality theories of Carl R. Rogers and Robert R. Sears. An analysis of earlier studies and critical reviews done in the area of interpersonal perception was made in an attempt to isolate important variables other than personality factors which have been shown to affect judgments of others and attempts were made to control for reprehensibility of traits, intelligence of subjects, and social factors of liking and association, nature of role relationships between subjects, similarity between judge and judged persons, extent of social interaction, and socioeconomic class.

The personality theories of Rogers and Sears both considered inaccuracies and distortions in judgments of others to be a function of discrepancy between the individual's concept of himself and how he realistically is (as measured by how others view him), and his awareness, or lack of awareness, of this discrepancy. Although both Rogers and Sears specify incongruence between the self concept and others' evaluation as a prerequisite for distortions and inaccuracies in judgments of others, Sears predicts projection or attribution of traits only when there is a lack of awareness of this incongruence while Rogers predicts projection only when the individual has some awareness of this incongruence. Sears predicts a process similar to projection, termed contrast formation, will be used whenever the individual has some awareness of the incongruence between self evaluation and evaluation by others.

The following hypotheses, stated in the null form, were drawn on the basis of the writings of Rogers and Sears. Hypothesis I: There is no relationship between inaccuracy in judgments of others and awareness of discrepancy between self evaluation and reality. Hypothesis II: There is no relationship between inaccuracy in judgments of others and reprehensibility of traits used for judgment.

To test these hypotheses, 153 student nurse subjects rated themselves (self concept), how they would ideally like to be (ideal self), and how others in their class would rate them (predicted self rating). Each subject also rated five classmates identified as liked associates and five classmates identified as nonassociates on the basis of a sociometric instrument administered several weeks before the self concept scales.

Patterns of self rating were used to identify subjects as congruent, incongruent and unaware of this incongruence, and incongruent and aware of this incongruence. Defensiveness in judgments of others operationally defined in terms of assigning an unwarranted degree of a reprehensible trait to others (projection) or assigning an unwarranted lesser degree of a reprehensible trait to others (contrast formation) were compared in these three groups. One analysis of these data investigated patterns of self ratings in groups of subjects classified as users of projection, users of contrast formation, or as accurate judges on the basis of comparisons of their ratings of classmates with the mean rating assigned to those classmates by all members of the group who rated them. Neither projection, contrast formation, or accuracy in judgment could be efficiently predicted on the basis of single measures of incongruence or awareness. A survey and comparison of patterns of self rating appearing in each of these groups also yielded inconclusive findings.

A second analysis of these data was done and procedures were used to control for extraneous factors arising as a function of unreliability of measurement, rating bias, and level of self rating. The results of this analysis are interpreted as supporting predictions derived from Rogerian personality theory that projection is a function of incongruence between self evaluation and reality and some minimal awareness of this incongruence. No evidence was obtained to support the psychoanalytic predictions regarding projection or contrast formation.

The results of this study are consistent with the statement that defensiveness in evaluation of others (attribution of traits) occurs primarily when behavior is relevant to the individual's self concept. Implications of these findings are discussed in relation to more recent studies in this area and an attempt is made to identify some areas for further investigation in consideration of the implications of the findings of this study for psychotherapeutic theory and practice. Microfilm $2.75; Xerox $7.80. 170 pages.

SOME EFFECTS OF UPPER EXTREMITY PROSTHETIC RESTORATION

(L. C. Card No. Mic 61-1420)

Pierre August Ventur, Ph.D.
Columbia University, 1961

This study evaluated the psychological consequences of prosthetic rehabilitation of the amputee in terms of changes in personality and of amputees' expectations about the extent of restoration that the artificial device would provide.

A sample of thirty-five unilateral, adult, male amputees who had not previously worn a prosthesis were provided with an individually prescribed device to satisfy the amputee's functional and cosmetic needs. A control group of amputees who had previously worn prostheses also were provided with an artificial device. These controls were matched with the experimental group on age, education,

type of amputation, side of amputation, marital status, and time elapsed since amputation. Amputees were selected on the basis of medical suitability, freedom from obvious emotional disorders, and willingness to cooperate with the research program.

Two questionnaires were developed to ascertain personality changes. The Prosthetic Attitude Questionnaire was designed to evaluate personality characteristics and attitudes along seven dimensions: Freedom from Sensitivity, Acceptance of Loss, Freedom from Frustration, Optimism, Functional Adequacy, Identification with Non-disabled, Acceptance by Others. The Prosthetic Expectations Questionnaire was designed to evaluate aspirations and expectations with regard to prosthetic restoration. It was administered only to the experimental group of amputees. Approximately six months elapsed between pre and post-test administration of the questionnaires.

In pre-test the mean scores of the control group for all scales indicated better psychological adjustment, although group differences were statistically significant only on the following scales: Freedom from Sensitivity, Acceptance of Loss, Identification with Non-disabled, Inferred Acceptance by Others. Although the relative superiority of the control over the experimental group at the beginning of the study was maintained at the end of the study, the experimental group tended to approach the control group.

The prosthesis had greater psychological significance for amputees who had not previously worn prostheses. The prosthesis seemed to improve the amputee's psychological adjustment. At the end of the study, after six months of prosthetic use, the experimental group was significantly less sensitive and frustrated, more optimistic and better able to accept loss than at its beginning.

Although the major purpose in prosthetic restoration was to improve manual and functional ability, the experimental group did not improve, as measured by the Functional Adequacy scale, suggesting that though objective functional improvements may have resulted from the prosthesis, the influences on attitudes was not appreciable.

Previous wearers of prostheses made significantly better scores on Functional Adequacy in post-test than in pre-test, suggesting that amputees who have had experience with prosthetic devices are more likely to favorably respond to the functional potential which a newer and improved prosthesis affords. These amputees also showed significant mean score increases in Acceptance of Loss. The fact that both groups showed significant increases in Acceptance of Loss suggests that prosthetic restoration, either initially or in repeated restoration, improves the amputee's ability to accept his loss.

The prosthesis apparently provided much of the cosmetic and functional restoration expected. However, there was greater variation in reactions to the prosthesis than in expectations of it. Some amputees found the prosthesis satisfied their expectations, others did not. Amputees who had difficulty in accepting their loss and who felt functionally inadequate were inclined to accept the prosthesis.

The experiment may be conceptualized as four periods of prosthetic use, from none to approximately four and one-half years. The longer the prosthetic device was worn, the better the psychological adjustment of the amputee as appraised on all scales except for Freedom from Frustration. Although prosthetic restoration tends to reduce frustration over a short time span, more extended use of the prosthesis no longer diminishes feelings of frustration. Microfilm $2.75; Xerox $5.60. 114 pages.

SEX-ROLE PREFERENCES OF EARLY ADOLESCENTS IN RELATION TO ADJUSTMENT

(L. C. Card No. Mic 61-1710)

Allen Paul Webb, Ph.D.
University of Southern California, 1961

Chairman: Professor Seward

Authorities dealing with the personality development and adjustment of boys and girls are continually stressing the major importance of achieving the role appropriate to one's sex. A number of studies have dealt with the masculinity-femininity dimension as it relates to adult adjustment, but few studies have examined sex-appropriate role preferences and adjustment in adolescents.

The present study investigated the possible relationships which might exist between sex-appropriate role preferences in early adolescents and various indices of adjustment. The assumption was made that the adolescent male will enhance his adjustment if he is able to make a masculine sex-role preference while the adolescent female will enhance her adjustment if her sex-role preference is flexible. These assumptions were based in part upon psychoanalytic thinking and in part upon observations of Western cultural phenomena. From these assumptions, three hypotheses were derived in regard to sex-role preferences and (1) manifest anxiety, (2) social acceptance, and (3) school absenteeism. For boys it was predicted that high femininity would be associated with high anxiety, low social acceptance, and a high rate of school absence. The same predictions were made for girls.

Subjects were 161 girls and 156 boys of junior high school age who were selected as representative of a Caucasian, middle-class, urban population. The experimental procedure consisted of group administration of the Femininity Scale of Gough's California Psychological Inventory, the Children's Manifest Anxiety Scale, and a Classroom Social Distance Scale. Each subject's school attendance record was also studied.

Comparisons of high- and low-anxiety girls supported the prediction that anxiety would be related to appropriate sex-role preference. The prediction was not supported in relation to boys. Social acceptance was not found to be related to appropriate sex-role preferences in either boys or girls. Comparisons of high- and low-absentee boys and girls supported the prediction that absenteeism would be related to appropriate sex-role preference. However, the direction of the association was the reverse of that predicted for both sexes. Boys and girls who had poor attendance records were both found to make masculine sex-role preferences.

The findings were regarded as offering some limited support to the psychoanalytic theory of development. It was also suggested that the male as well as the female role may be in a state of confusion during the period of early adolescence. A possible lack of consistency in the social acceptance which is accorded the masculine and the feminine

qualities in both sexes was noted. It was also suggested that boys and girls who have unusually high feminine role preferences find their greatest satisfactions and security in good school attendance, but may also use school as a defense which could delay a successful resolution of the sex-role dilemma. Further investigation is needed in this area. Microfilm $2.75; Xerox $4.80. 95 pages.

PSYCHOLOGY, EXPERIMENTAL

ROTATION OF DOT PATTERNS AS STIMULI FOR THE PERCEPTION OF MOTION IN THREE DIMENSIONS: THE EFFECTS OF NUMEROSITY AND PERSPECTIVE.

(L. C. Card No. Mic 61-1720)

Myron Lee Braunstein, Ph.D.
University of Michigan, 1961

Cues to depth which depend upon the observation of continuous transformations of visual displays may be isolated by the study of certain transformations of abstract patterns which provide no depth cues when stationary. Such transformations have for some time been regarded as sources of illusions and have only recently been recognized as important to the study of depth perception.

The present research deals with displays of projections of points as these points are rotated about a vertical axis. The effects of numerosity and of perspective (the ratio of the distance from the projection point to the most distant plane of the display to the distance from the projection point to the closest plane of the display) on judgments of the strength of the depth impression and of the coherence of the displays, are investigated.

Stimuli were prepared by photography from the cathode-ray-tube output of a digital computer. The displays represented the twenty combinations of five levels of numerosity (2, 3, 4, 5 and 6 points) and four levels of perspective (1.00 or parallel, 1.13, 1.67 and 3.00). Pairs of displays representing all pairs of treatment combinations were presented to each subject. Subjects in one experiment were asked to indicate which display in each pair gave the stronger impression of occurring in space rather than on a flat surface. In a second experiment, subjects were asked to judge which of the displays in the pair was more coherent, with coherence defined as the degree to which the elements in a display maintain the same relative positions as the display moves.

The proportion of trials on which a stimulus was judged to give a stronger impression of occurring in space than the stimulus with which it was paired was found to be an approximately linear function of the logarithm of the number of points in the display. Displays produced with greater perspective tended to be chosen as giving stronger depth impressions, but the effect of perspective was secondary to that of numerosity.

When coherence judgments were used as the dependent variable, perspective became the more important factor. Stimuli with lesser perspective were judged more coherent. Displays of two points in rotation tended to be judged more coherent than displays of greater numbers of points.

A few displays were included which were not projections of rigidly rotating patterns, but were projections of points rotating at different speeds about the same axis. These were judged to give stronger depth impressions than the rigidly rotating patterns. This result, combined with the difference in the effect of the treatment dimensions for the dependent variables in the two experiments, indicates that depth judgments and coherence judgments may not be assumed equivalent.

The results of the present research do not lend differential support to the theories which have been applied to this area of perception, but do cast doubt upon the assumption made to some extent by all of these approaches, that the perception of motion in three dimensions in such displays results from a tendency toward the perception of rigidly moving patterns.

Microfilm $2.75; Xerox $4.80. 95 pages.

ISOHEDONIC CONTOURS IN THE SUCROSE-SODIUM CHLORIDE AREA OF GUSTATORY STIMULATION

(L. C. Card No. Mic 61-104)

Kent Ronald Christensen, Ph.D.
University of Illinois, 1960

Thirty-one need-free female albino rats were given a series of preference tests between simple sucrose standard solutions and compound comparison solutions containing both sucrose and sodium chloride. All compound solutions contained either 0.5%, 1%, 2%, 4%, or 8% NaCl and a variable amount of sucrose. The rats were tested in a battery of electronic preference testers using the "up and down" method. A series of compound solutions was found that was isohedonic to a 1% sucrose standard. Other series were determined which were isohedonic to simple solutions containing 2%, 4%, 8%, and 16% sucrose. Isohedonic contours were formed by joining all equivalent points. The shape of the contours was shown to correlate well with other preference and electrophysiological data.

The "up and down" method was shown to possess several advantages for preference research. It minimizes both the repetition effect and the formation of position habits and is temporally efficient. Its chief advantage was shown to be its reliability. Seventeen of the isohedonic points were replicated using the same animals. Eleven of the second determinations were within one standard error of the first, and none were more distant than two standard errors.

Microfilm $2.75; Xerox $3.00. 52 pages.

THE CORNEAL AFFERENT SYSTEM: A DEVIATION FROM HELMHOLTZ'S THEORY OF SPECIFIC FIBER ENERGIES.

(L. C. Card No. Mic 61-1280)

William W. Dawson, Ph.D.
The Florida State University, 1961

Records of afferent neural potentials are reported from the temporal long ciliary nerve of the cat during stimulation

of the cornea by radiant and conducted energy, stimuli normally tactile or painful in quality, and by the cooling effects of ethyl chloride. Spectrophotometric examination of the cornea indicates radiant stimulus transmission to substructures. The afferent effects of such transmitted stimuli are localized to the iris by means of selective anesthesia.

Although not directly related to thermal sensation by the author, conducted warming of the cornea produces afferent thresholds which correspond well with psychophysical data from areas also supplied with trigeminal fibers. These thresholds are compared to classical difference threshold measures and yield a relationship which appears similar in form to the psychophysical relation Log $\Delta 1/1$. Other data relates the temporal long ciliary nerve to its nasal counterpart and examines the gradients set up by thermal stimulation of the cornea as contrasted to those produced upon the skin of a human.

The sensitivity of unmodified nerve endings which is seen in this system is considered a basis for re-examination of the classical specific fiber-specific stimulus concept. The general paucity of information about this ending type is emphasized and warrants further investigation of their role in peripheral sensation.

Microfilm $2.75; Xerox $5.40. 107 pages.

CHANGES IN INSTRUMENTAL RESPONSE SPEED FOLLOWING REWARDED ENDBOX PLACEMENT

(L. C. Card No. Mic 61-1750)

James Ratcliffe Ison, Ph.D.
University of Michigan, 1961

The analysis of instrumental approach behavior proposed by Spence (1956) predicts that rewarded endbox placement will increase the speed of the instrumental approach response if the stimuli present in the runway are similar to the stimuli present in the endbox. Two experiments (Stein, 1957, and Swift and Wike, 1958) performed in the context of this analysis failed to demonstrate any effect of endbox feedings on running speed. In the present experiment a number of conditions were explored in which endbox feedings might influence the speed of the instrumental response.

Six groups of food deprived rats were given nine non-food terminated runs in a straight-alley apparatus. For all six groups the starting box and runway were black, for three groups the endbox was black and for three groups the endbox was white. The Ss subsequently were given nine placements into the appropriate baited endbox. Two groups were placed over the foodcup at the end of the endbox, two groups were placed over the foodcup at the center of the endbox, and two groups were placed at the beginning of the endbox from where they ran to the foodcup at the end. All Ss then received a test run through the apparatus.

Four measures were recorded: starting box speed, runway speed (recorded before the endbox cues were visible), endbox entry speed, and endbox running speed. In starting speed there were no differences between Trials 9 and 10. In the runway the group fed in the center of the black endbox demonstrated a significant increase on Trial 10. In the endbox measures the groups fed in the center of the endbox and the groups which ran to the end of the endbox increased in speed.

The increase in running speed in the runway demonstrated by the group fed in the center of the black endbox, and the increases of the four groups in the endbox measures was interpreted as consistent with the analysis proposed by Spence. This analysis states that the effect of the feedings was to condition the fractional goal response, r_g, to the endbox stimuli, and that r_g generalized from the black endbox to the black runway. The simultaneous occurrence of r_g and the instrumental response, R_a, resulted in the increased speed of R_a. This experiment suggests that the previous failure to demonstrate the increase in running speed can be attributed to a failure to ensure that S received the appropriate endbox stimuli at the time of the consummatory response.

Microfilm $2.75; Xerox $3.80. 66 pages.

AN EXPERIMENTAL EXPLORATION OF THE INTERACTION BETWEEN TEACHING AND LEARNING BEHAVIOR

(L. C. Card No. Mic 61-1632)

Felix Friedrich Kopstein, Ph.D.
University of Illinois, 1961

The advent of automated instruction has focussed attention on the problems of programming (i.e., the manner and sequence in which instructional information is presented) teaching machines. Presumably programming is most efficient when it adaptively adjusts the teaching presentation to the needs of the individual learner. In the first experiment subjects were required to learn a list of six paired-associate items each consisting of a color name as the stimulus term and four pseudo-words as response term. Three adaptive programming variables were examined: (1) "Teaching Rate" sought to match the rate at which new material was presented to indications of the rate at which each individual learner assimilated this material. (2) "Prompting" provided the correct response, if desired, but surrounded by three similar responses so that uncertainty was associated with each prompt. (3) "Pacing" allowed the subject to determine the duration of stimulus exposure and of the response anticipation period. Adaptive treatments were contrasted with non-adaptive treatments in which no account was taken of the subject's ability to assimilate new material, no prompts were given, and the duration of stimulus exposure was determined by the experimenter. The number of trials and the number of minutes required to achieve one errorless repetition were scored during original learning. A week later a delayed transfer task, or application task was administered and errors made as well as time taken to complete it were scored. Only "pacing" produced statistically significant differences and only with respect to the "number-of-trials" measure; self-paced subjects took fewer trials than experimenter-paced ones. Similar differences could not be shown for the learning time measure.

To account for these unexpected findings it was hypothesized that subjects rehearsed spontaneously and covertly during training thus giving the experimenter only

tenuous control over practice, at best, and making the chosen indices for adaptation inappropriate. This hypothesis was tested in a second experiment. Learning materials employed in the first experiment were used again. The experimental design was such that some groups practiced for the same length of time, but for different numbers of trials while others received the same number of trials, but practiced for a greater and lesser time. Results showed that the total amount of practice (study time) rather than the number of trials (number of controlled reinforcements) determines how much is learned. Expected distributional effects did not materialize. As an incidental finding it was established that memorization of key terms in a task such as the learning of procedural directions is more efficient when contextual verbal (sentence) material is omitted.

A third experiment involving an expanded experimental design was conducted to verify the results of the second one. It established clearly that the amount of practice (study) time rather than the pace of presentation, or the number of trials during practice determines the degree of mastery that will be attained.

Microfilm $2.75; Xerox $7.20. 152 pages.

ACQUISITION AND REVERSAL OF A DISCRIMINATION HABIT AS A FUNCTION OF PRE AND POST SCHEDULE OF REINFORCEMENT AND LENGTH OF TRAINING SERIES

(L. C. Card No. Mic 61-1369)

Garvin Marvin McCain, Ph.D.
The University of Texas, 1961

Supervisor: Dr. E. J. Capaldi

Six groups of white rats were given 34 acquisition trials and six groups were given 154 trials prior to response reversal on a T-maze. There were three reinforcement schedules during acquisition, 50% random, 50% alternating and 100%. One half of the 50% random and 100% groups received 50% random reinforcement during response reversal. The remaining half received 100% reinforcement. One half the subjects receiving 50% alternating reinforcement in acquisition received 100% and one half receiving 50% alternating reinforcement during response reversal.

The results were:

1. During the first 11 days of acquisition, the 100% reinforcement groups made slightly fewer errors than the partial reinforcement groups based on all trials.
2. Compared on trials following reinforcement, partial reinforcement groups made significantly fewer errors than the 100% group throughout acquisition.
3. During the last seven days of extended acquisition, errors on nonreinforced trials increased significantly for the 50% alternating group.
4. The 50% random reinforcement group made significantly fewer errors in the last seven days of extended acquisition than the 100% reinforcement group.
5. Groups receiving 100% reinforcement during response reversal made significantly fewer errors and reached criterion in significantly fewer trials based on all trials. Due to confounding factors no analysis of trials following reinforcement during reversal was made.
6. Reinforcement schedule in acquisition was not a significant variable between 50% random reinforcement and 100% reinforcement groups in trials to reversal criterion, but was significant if based on errors during response reversal.
7. Performance was superior in reversal for all animals receiving 50% alternating reinforcement in acquisition compared to all the other Ss considered as one group.
8. Extended acquisition training increased both error scores and trials to reversal criterion in groups receiving 50% random and 100% reinforcement in acquisition.
9. Increased training caused no significant change in error scores or trials to reversal criterion where the acquisition reinforcement schedule was 50% alternating. There was a significant interaction between length of training and reinforcement schedule in response reversal for both the error scores and trials to criterion.

The lower error scores of the partial reinforcement groups during acquisition was attributed to an increased general motivational factor. The increasing tendency to make "incorrect" responses on nonreinforced trials of the alternating reinforcement schedule indicated Ss had learned either a pattern or responses to specific stimulus conditions of particular trials.

Superior performance in error scores and trials to reversal criterion by groups reversed on a 100% reinforcement schedule may be due to the higher error scores of the partial reinforcement groups on trials following nonreinforcement.

The increase in trials to criterion following increased acquisition trials was not considered as incompatible with earlier findings. The possibility of a curvilinear relation between length of training and trials to a reversal criterion was considered.

Predictions of performance during reversal seemed to require specification of the effects of: reinforcement schedules during acquisition and reversal, and different lengths of training.

Microfilm $2.75; Xerox $3.80. 67 pages.

THE RELATIONSHIP OF TEST-DEFINED NEEDS TO ILLUMINANCE MATCHES OF NEED-RELATED PICTURES

(L. C. Card No. Mic 61-1930)

Mary Louise Phelps McClenahan, Ph.D.
State University of Iowa, 1961

Chairman: Professor Judson S. Brown

The present investigation was designed to study the relationship of a) need-for-achievement, hostility, repression-expression, and the sex need to b) illuminance matches of need-related and neutral pictures.

One hundred and seventy-two introductory psychology students were selected as Ss on the basis of scores on the Achievement Imagery Scale of the Iowa Picture Interpretation Test, the Hysteria and Psychasthenia Scales of the MMPI, and Siegel's Manifest Hostility Scale. Subjects were presented with landscape pictures (Set L), neutral

pictures of people (Set P), and one set of need-related pictures as follows:

a) Twenty-four High AI and twenty-four Low AI Ss were shown achievement-related pictures. Separate sets of these pictures were used for males and females.

b) Twenty-four subjects who scored high and twenty-one Ss who scored low on the distribution of Hy-Pt scores were presented with sex-related pictures. Separate sets were shown to male and female subjects.

c) The following four groups were presented with hostility-related pictures: High Hy-Pt, High MHS; High Hy-Pt, Low MHS; Low Hy-Pt, High MHS; and Low Hy-Pt, Low MHS. There were 12, 29, 24, and 13 subjects in these groups. Separate sets of pictures were used for males and females.

During an experimental session each picture was projected on a screen first at a standard brightness and then at a brightness either higher or lower than the standard. The subject's task was to manipulate a Variac (which controlled the voltage into the projection lamp) until the picture looked the same as it did on the first presentation.

The following scores were obtained for each subject: mean Variac settings for the landscape pictures (Set L), the neutral pictures of people (Set P), and the need-related pictures; and a difference score which consisted of the S's mean for the need-related pictures minus his mean for Set P.

The principal findings were as follows:

1. Subjects in the High AI Group made significantly higher difference scores than Ss in the Low AI Group.
2. Subjects with high MHS scores obtained significantly higher difference scores than subjects with low scores on the MHS.
3. Males who were shown the hostility-related pictures made significantly higher difference scores than did females who were shown these pictures.
4. There were no differences related to Hy-Pt scores.

In general, the results were consistent with the statement that the brightness matching task using need-related pictures is sensitive to differences in test-defined learned needs. Microfilm $2.75; Xerox $6.00. 122 pages.

FACTORS AFFECTING THE CHOICE-POINT BEHAVIOR OF THE RAT: ALTERNATION AND STIMULUS CHANGE.

(L. C. Card No. Mic 61-1772)

Richard Howard O'Connell, Ph.D.
University of Michigan, 1961

There has been in recent years an accumulation of data and theory pertaining to the T-maze choice behavior of rats whose physiological needs have been met. One finding is that rats, when given two consecutive free choices in a T maze, tend to alternate on the second trial by choosing the previously unchosen side. If a first trial consists of visual exposure to the maze arms through glass barriers placed at the choice point, then, on a second trial, with barriers removed, rats tend to choose an arm which has been changed in brightness between trials.

Two types of theory have been used to account for the alternation or stimulus-change results. The tedium theories use concepts which imply avoidance: "reactive inhibition," "stimulus satiation," "action decrement." Titillation theories emphasize the attractiveness of new stimuli by employing such terms as "curiosity response," "exploratory drive," and "novelty."

This study considers two areas in which differential prediction for the two types of theory has been claimed: the relative ability of the theories to deal with both alternation and stimulus-change phenomena, and the manner in which choice speed changes over time. It is argued that there is not a clear difference in prediction for either of the areas suggested as critical. However, differences may exist between alternation, to which tedium theories are more frequently applied, and the response to stimulus change, usually accounted for by titillation concepts. It is the purpose of the present experiment to examine these two phenomena within the context of a single experiment.

The first question asked is whether the percentage of choice may be varied by combining the first-trial operations which produce alternation and response to change. Two models are presented which offer alternative ways of conceptualizing how the combined effects of the alternation and stimulus-change operations may act in conjunction with the subjects' preferences to yield a given percentage of choice.

A second question is whether the choice-time measure reveals differences between alternation and stimulus change. It was hoped a third question, the possible contribution of brightness alternation to place alternation, might also be answered.

There were eight experimental conditions, which consisted of combinations of the place alternation operation, the stimulus-change operation, and brightness preference and alternation. Each of 64 subjects experienced each condition in a balanced order. The percentages of choice of the alternatives of the conditions were in the general order expected if the alternation and stimulus-change operations combine their effects. The percentages of choice were well fit by the second model, and poorly fit by the first. The effect of brightness alternation was indeterminate.

There was a significant increase over time in the percentage of subjects alternating, but none in the number responding to stimulus change. Second-trial choice speeds fell into two groups: those of subjects alternating, and those of subjects repeating the choice of first-trial place. Within each of these sets, choice speed was a positive function of relative frequency of choice, but the repeat choices as a whole were significantly faster than the alternation choices.

Choice speed also varied over time. Second trials had slower choices than first trials, contrary to the predictions of either tedium or titillation theories. Over successive experimental days, choice speeds for both first and second trials displayed an inverted U function, which is in agreement with one interpretation of titillation theory.

It may be concluded that alternation and response to stimulus change do show differences on both choice measures. The second model, which assumes a statistical decision process, shows promise for aiding in the interpretation of these data.

Microfilm $2.75; Xerox $5.60. 111 pages.

THE EFFICACY OF SOME COMMONLY USED VERBAL STIMULI AS A FUNCTION OF THE RESPONSE CLASS WITH WHICH THEY ARE USED

(L. C. Card No. Mic 61-1292)

Thomas Damon Prutsman, Ph.D.
The Florida State University, 1961

This experiment investigated the effects of three commonly used verbal stimuli ("huh-uh," "mmmhmm," and "good") in three response class categories (proper nouns, plural nouns, and modifiers) where an attempt had been made to vary the amount of homogeneity of the response class categories from more homogeneity to more heterogeneity. Homogeneity was defined as percentage of emission of different parts of speech in a word giving session. Pilot work demonstrated that proper nouns represented four percent of the words given and that this represented more homogeneity than did plural nouns with 11% occurrence or modifiers with 14% occurrence. The verbal stimuli were chosen because their inclusion made possible the comparison of results with previous studies using the same stimuli.

One hundred Ss were randomly assigned to nine experimental groups and one control group. Each of the three stimuli were used in each response class. No stimulus was used with the control group.

The chosen verbal stimulus was spoken by E as contiguously as possible with each emission of the chosen response class by S during the first fifteen minutes. The second fifteen minutes was extinction and no stimuli were administered.

Post experimental questioning revealed no Ss who were aware of the stimulus-response class contingency, and no Ss who made bipolar interpretations of the stimulus according to preset criterions.

Analysis of variance revealed significant Fs in both acquisition and extinction phases of plural nouns and in the acquisition phase of modifiers. The significant Fs were considered to be evidence of significant differences among the verbal stimuli used with regard to their reinforcing values. Tukey's "Gap Test" was utilized among the individual group means to isolate and clarify where the between group significance arose. Means of groups significantly different than the control group mean were considered to be evidence of verbal conditioning having taken place. The lack of statistical significance in the response class proper nouns was attributed to gross variability of control group Ss.

The principal finding of this study was that the magnitude of effect of the positive verbal stimuli "mmmhmm" and "good" appears to be directly related to the class of response with which they were used. "Mmmhmm" was the most effective with plural nouns and "good" was the most effective with modifiers. This lends support to the postulations of earlier workers in the field of verbal behavior that there is an interaction effect between meaningfulness of verbal stimuli and meaningfulness or homogeneity of the response class within which they are used.

The negative verbal stimulus "huh-uh" tended to decrease the frequency of emission of the sought after response class in all response classes.

The implications of this study were its pointing out that future research should be directed toward empirically defining awareness and exercising more efficient controls over examiner differences.

Also, the need for scaling of both verbal stimuli and response classes as to meaningfulness, homogeneity, and manipulative effect was discussed as were suggestions for lessening variability in verbal conditioning studies.

Microfilm $2.75; Xerox $3.00. 56 pages.

THE EFFECT OF SUBCORTICAL STIMULATION ON MEMORY AND RESPONSIVENESS IN RATS

(L. C. Card No. Mic 61-1774)

Ausma Rabe, Ph.D.
University of Michigan, 1961

This experiment was designed to investigate the possibility that electrical stimulation in subcortical areas of the brain may affect the formation of memory traces and the animal's responsiveness to the environment differentially, depending on (1) the neuroanatomical area stimulated, (2) the time when brain stimulation is applied during the behavioral sequence, and (3) the novelty of the experimental problem.

Fifty-six rats, with bipolar electrodes implanted in either the hippocampus or the non-specific nuclei of the thalamus, were run on a series of problems in a Hebb-Williams maze.

Following pre-training in the maze, the rats were divided into seven groups of eight animals each. Three groups had electrodes in the hippocampus and three groups had electrodes in the thalamus. The animals in the control group were implanted either in the hippocampus or the thalamus but never received electrical stimulation. Every animal was given a training trial, followed in one hour by a test trial, on each of eight experimental days. Four of the tests trials were on the same problems as the training trials; the other four test trials were on different problems.

Electrical stimulation was applied at one of three different times in relation to the two behavioral trials: (1) immediately after the training trial, or (2) in the middle of the one-hour intertrial interval, or (3) immediately before the test trial. There were two groups, one hippocampal and one thalamic, for each of the three times of stimulation. Each group was stimulated at one time interval only. The control group remained unstimulated. A self-stimulation test indicated that the stimulating current was neither rewarding nor punishing for all but two of the animals.

The rat's behavior was measured in terms of errors made during the trials in the maze, as well as response latencies in moving from the starting-box to the problem area of the maze.

Stimulation of the hippocampus after a training trial produced a decrease in errors when the test problem was the same as the training problem and an increase in errors when the test problem was different. This finding suggests that hippocampal stimulation after the training trial enhanced retention of the training problem by facilitating the memory trace process formed during the trial.

Hippocampal stimulation in the intertrial interval had

no significant effect on either error or latency difference scores.

Stimulation of the hippocampus immediately before the test trials led to an increase in errors on both the same and different test problems. This increase in errors could reflect any one of three possible different effects of stimulation: (1) decreased responsiveness (such as decreased attention and lowered level of arousal), (2) increased arousal and increased exploratory behavior, or (3) confusion. This increase in errors from hippocampal stimulation before a trial was also accompanied by increased response latencies. This may indicate the presence of motor inhibition, decreased arousal, or increased exploratory behavior.

Stimulation of the non-specific thalamic nuclei had no effect on either errors or latencies at any of the three times of stimulation in terms of difference scores.

It was speculated that hippocampal stimulation, by affecting electrical activity in the reticulo-cortical arousal systems, may enhance retention and produce changes in responsiveness.

The possible reasons for the absence of effects from thalamic stimulation were also discussed.

Microfilm $2.75; Xerox $4.80. 92 pages.

THE EFFECT OF ELECTRICAL STIMULATION OF THE THALAMUS ON THE PERFORMANCE OF RATS DURING VISUAL DISCRIMINATION LEARNING

(L. C. Card No. Mic 61-1778)

Ina Samuels, Ph.D.
University of Michigan, 1961

The purpose of the present experiments was to explore the effect of electrical stimulation of the nonspecific thalamic nuclei on learning and performance in terms of two variables: (1) the motivational properties of thalamic stimulation, and (2) the novelty and complexity of the task.

Fifty-five rats (thirty-eight implanted with bipolar electrodes in the nonspecific thalamic nuclei, nine operated controls and eight unoperated controls) were trained on visual discrimination problems in a Y-maze. In Experiment B (stimulation before the choice point), twenty-six of the animals were trained in a "no choice" situation to approach narrow vertical stripes for a food reward. They were then transferred to a choice problem of broad vs. narrow vertical stripes, with the training stimulus of narrow vertical stripes remaining the positive stimulus. Brain stimulation was given for five seconds in the starting box and continued until the animal reached the choice point of the Y-maze. In Experiment D (stimulation during the trial), the remaining twenty-nine animals were first trained to criterion on a discrimination problem of broad vs. narrow vertical stripes, and then transferred to a comparable problem involving horizontal stripes. The narrow striped pattern was the rewarded stimulus in both tasks. Brain stimulation was given from the moment the animal left the starting box until the discriminatory response was completed. All animals were subsequently given a self-stimulation test in a Skinner box to determine the motivational properties of the brain stimulation.

The experimental design permits the results to be considered in terms of two variables:

I. Motivational properties of stimulation. On the basis of the self-stimulation tests, stimulated animals were classified as "motivational" and "neutral" self-stimulators. Motivational stimulation during the test trials increases both the number of errors and the number of trials to criterion; neutral stimulation during the test trials decreases errors as well as trials to criterion.

II. Novelty and complexity of the task as related to the effects of brain stimulation. Stimulated experimental and unstimulated control animals were compared in situations which differed with respect to (1) the novelty of the task ("novel," "partially novel," and "familiar") and (2) the complexity of the task ("no choice" vs. "choice"). In general, both stimulated and unstimulated animals showed slower response latencies with increasing novelty of the task and greater complexity of the task. There was interaction between stimulation and novelty, and between stimulation and complexity. Stimulation had little or no effect upon latencies in a "familiar" situation, but slowed latencies significantly in "partially novel" or "novel" situations. Similarly, in a "no choice" situation, there was little difference between stimulated and unstimulated groups; in a situation involving "choice," however, stimulated animals were much slower than controls.

The slower latencies in all situations were interpreted to be the result of increased exploratory activity. The findings were discussed in terms of the relation of generalized and localized cortical arousal to exploratory behavior. Microfilm $2.75; Xerox $4.60. 87 pages.

FRUSTRATION AND ANXIETY: A STUDY OF DIFFERENCES BETWEEN FRUSTRATION AND ANXIETY DRIVE PROPERTIES IN SELECTIVE LEARNING.

(L. C. Card No. Mic 61-349)

Thomas Howard Shaw, Ph.D.
New York University, 1960

The problem of this investigation was to determine the differences between frustration and anxiety as to drive properties in a selective learning situation. The criterion was the learning of a position habit by the trial and error method. Learning was evaluated in terms of trials, errors and latency. The propositions that frustration-drive is a transitory state and that anxiety has greater maintaining and sustaining drive properties were evaluated in relation to the following hypotheses:

1. The frustration-drive group will have significantly greater mean-errors in learning a position habit over the first six response-sequences than the anxiety-drive and control groups.
2. The frustration-drive group will have a significantly greater mean-response delay over the first six response-sequences in learning a position habit than the anxiety-drive and control groups.
3. The frustration-drive group will have significantly smaller number of total [illegible]-trials in learning a position habit than the anxiety-drive group.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

4. The anxiety-drive group will have a significantly larger number of total mean-errors in learning a position habit than the frustration-drive and control groups.
5. The anxiety-drive group will have a significantly greater total mean-response delay in learning a position habit than the frustration-drive and control groups.
6. The anxiety-drive group will have a significantly larger number of total mean-trials in learning a position habit than the frustration-drive and control groups.

These experimental hypotheses were tested against the null hypothesis at the .05 level of confidence. The hypotheses were tested with the assumption that the blocking of a series of instrumental responses and the consummatory response produce frustration and that a learned anticipatory response to a noxious stimulus, electric shock, produces anxiety.

The design of the experiment was of the simple randomized type using the analysis of variance technique. The Sample consisted of fifty-four male students in introductory psychology classes. Three treatment conditions, viz., frustration, anxiety and non-stress were independently administered to three groups of eighteen Ss. The experimental apparatus was a temporal maze consisting of a stimulus presentation board with red, green and white lights and two response keys. Ss pressed one or the other of the keys until they learned a position-habit which was set in the apparatus with a selector switch by the Experimenter. The overt deviant behavior of Ss was recorded during the pre-test and criterion phases. Following the criterion-testing, Ss were interviewed as to covert behavior by means of a Subject Reaction Inventory consisting of thirty statements reflecting feeling states provoked by frustration, anxiety and non-stress.

The findings of the study resulted in rejection of the null hypothesis in all instances at the .05 level of confidence. These findings gave substantial support to the experiment hypotheses that frustration leads to poor performance as to errors and latencies during the critical trials following which there is, apparently, a diminution of the effect. Anxiety-provoked Ss by comparison, at least in this type of complex learning situation, consistently showed a poorer performance as to trials, errors and latencies during the total criterion phase. The Reaction Inventory categorized Ss into frustration and anxiety-provoked groups and a non-emotional group. An hypothesis of the independence of these choices was rejected, the probability of chance factors operating was considerably less than the .001 level of confidence. The greater frequency of occurrence of deviant overt behavior in frustration and anxiety-provoked Ss during the criterion phase was interpreted as evidence of a higher drive state.

The findings of this study were interpreted within the framework of learning theory and the Brown and Farber hypothesis of frustration. They lend substantial support to the propositions that frustration-drive is transitory and that anxiety has greater maintaining and sustaining drive properties. Microfilm $2.75; Xerox $6.00. 125 pages.

PERFORMANCE IN INSTRUMENTAL CONDITIONING AS A JOINT FUNCTION OF TIME OF DEPRIVATION AND SUCROSE CONCENTRATION

(L. C. Card No. Mic 61-1377)

John Roberts Stabler, Ph.D.
The University of Texas, 1961

Supervisor: Professor Alfred Castaneda

This experiment was primarily concerned with the joint effects of concentration of sucrose incentive and hours of food deprivation upon locomoter behavior in a straight alley. Three levels of concentration and two levels of drive were employed in a factorial design with six groups of male rats. Running speed and frequency of stops were recorded for 60 acquisition trials.

The major finding was that asymptotic running speed showed a significant interaction between the drive and incentive variables. The frequency of stops appeared to be inversely related to running speed. Start-box and runway measures, and measures based upon either the first trial of each day or upon all trials of each day, were generally consistent. The results were discussed in terms of Spence's (1956) incentive motivation hypotheses concerning the action of incentives in instrumental reward conditioning.

A second stage of the experiment was conducted in order to determine whether Ss run to a small quantity of sucrose solution over an extended period of time eventually learn to respond to the incentive in terms of its hunger-reducing qualities.

For another 60 trials, i.e., 20 more days, half the Ss in each experimental group were allowed to consume large quantities of the same concentration sucrose solution as they had been receiving in the goal-box. A significant D effect was obtained from the asymptotic running speeds at the end of Stage 2. It was interpreted as evidence that Ss must be hungry in order to learn that sucrose solutions are need-reducing and, secondly, that Ss which are rewarded with small amounts of sucrose solution over an extended period of time respond to the incentive in terms of its palatability rather than in terms of its need-reducing potential. Microfilm $2.75; Xerox $4.20. 80 pages.

THE DISCRIMINATION LIMEN FOR LOUDNESS UNDER VARYING RATES OF INTENSITY CHANGE

(L. C. Card No. Mic 61-1814)

David Wolsk, Ph.D.
University of Michigan, 1961

Two studies have been conducted on the influence of the rate of auditory intensity change upon a subject's ability to discriminate that change.

In Experiment I a sliding stimulus of 1000 cycles per second at 20 decibels above threshold with rates of intensity change varying in five steps between 2 and 150 decibels per minute was used with four subjects. Complete psychophysical functions under a variation of the method of constant stimulus differences were obtained at each rate of

change for a total of approximately 50 hours testing per subject. To control for possible differential auditory fatigue and/or adaptation effects, a stable level of fatigue was maintained throughout the trials. The data were analyzed using a three-way analysis of variance. There were significant main and interaction effects for all three variables: rates of stimulus change, subjects, and percentage of correct choice. The slowest rate of change was the only one which produced results significantly different from the other rates, and this was so for only two of the four subjects.

In Experiment II a warbling type of intensity variation was produced by beating two slightly mistuned pure tones together. The stimulus tones were at approximately 50 decibels above threshold. The warble rates varied in four steps between 0.3 and 3.0 beats per second. Ten subjects were used under a self-adjustment method. The rate of change of the warble amplitude was adjusted for each warble rate as a compensation for the fewer number of warble cycles presented in a given observation time with the slower warble rates. In other words, where the change to be perceived consumed a longer duration, a longer observation time was allowed. This control has apparently not been used before in two previous similar studies whose results indicated a very definite decrement in discrimination as the warble rate decreased. The results from this experiment showed no significant effects on the discrimination limen (DL) from varying the warble rate.

The primary conclusion is that, within a broad range of rates of stimulus change, the loudness DL is not significantly influenced by varying the rate of change. The discrimination of continuous loudness changes can be based upon a comparison of the intensities at two points in time, or alternatively, upon hearing the loudness change itself. The present experiments indicate that when the latter approach is primarily used, the rate of stimulus change does not significantly affect the DL. Some type of temporal integration process in the central nervous system must be operative for this to be the case. With extremely slow loudness changes, where it is difficult or impossible to hear the loudness change per se, the comparative approach apparently becomes dominant. This results in decreased sensitivity and a significant influence of the rate of change variable. Microfilm $2.75; Xerox $3.00. 47 pages.

RELIGION

TOWARD A CONTEMPORARY THEOLOGY OF PREACHING: AN HISTORICAL STUDY OF THE NATURE AND PURPOSE OF PREACHING (WITH SPECIAL REFERENCE TO REPRESENTATIVE WORKS OF HOMILETICAL THEORY).

(L. C. Card No. Mic 60-6695)

Conrad Harry Massa, Th.D.
Princeton Theological Seminary, 1960

Problem:

An adequate theological understanding of the nature and purpose of preaching has not been provided by doctrinal or biblical studies. The problem is to approach the understanding of preaching as a problem in practical theology to determine what actually has been the working understanding of the "office of preaching," and to determine the theological implications and contributions of the understanding gained through such an approach.

Procedure:

An understanding of preaching is approached through representative writings on homiletics from the ancient, medieval, reformation, and post-reformation periods in Part I. In Part II an exhaustive analysis is made of works in American Protestant Homiletics. Writings on homiletics are used, rather than sermons, since the former provide explicit concepts of preaching and are corporate, rather than individual, in both their inception and their effect.

Results:

1) Historically there has been a continuing frame of reference by which preaching can be analyzed and understood. 2) Until about 1870, homileticians gave the aims of preaching in terms of the aims of the classical Ciceronian rhetoric. From 1870 on, another group began to stress the interpretative aim of preaching. 3) Twentieth century American Protestant homiletics has been concerned with: a) the totality of the challenge to preaching, b) the submergence of the individual in the corporate, c) the quest for religious or spiritual reality. 4) Twentieth century American Protestant homiletics has seen preaching as a) dynamic event in which the important factors are not, as traditionally, content and delivery, but are the objective and subjective factors whose relationship give preaching its FORM as a particular actualization of the meaning of the Gospel; b) interpretative event whose purpose in neither persuasion, nor the interpretation of the Bible, nor the interpretation of doctrine, but the theological interpretation of the total life of the hearer.

Conclusions:

1) The approach to the understanding of preaching as a problem in practical theology is justified. 2) The contextual nature of preaching provides both the "constant" necessary for historical comparison and the means necessary to understand historical variations. 3) In the twentieth century every aspect of preaching's frame of reference has been challenged in the same era. 4) The use of rhetorical aims for preaching was necessary to maintain

a balance and to emphasize the centrality of the hearer for the preaching event. 5) Preaching may now be related to the hearer through its basic nature as theological interpretation. 6) Preaching starts with the fact that the preacher is a theologian; and theology, not exegesis, is the basic homiletical discipline. 7) Homiletics discovers the opposite end of the interpretation-communication process which biblical criticism discovered. 8) The public nature of preaching may be the particular characteristic which differentiates it from other aspects of the ministry. The preacher is the Popularizer of the Gospel. 9) Definition: Preaching is an event in which a man speaking to other men gives a theological interpretation of their individual and corporate life on the basis of the biblical witness, under the guidance of the living Spirit of God, and in terms relevant and related to the specific context in which the event is taking place.

Microfilm $4.55; Xerox $16.20. 356 pages.

THE PRIMITIVE CHRISTIAN HOMOLOGIA ACCORDING TO THE NEW TESTAMENT

(L. C. Card No. Mic 60-6696)

Vernon Harry Neufeld, Th.D.
Princeton Theological Seminary, 1960

Supervisor: Dr. Bruce M. Metzger

The primitive Christian homologia (confession) in the early church was the agreement or consensus in which the Christian community was united, that core of essential conviction and belief to which they subscribed and openly testified. Several lines of evidence support this conclusion, namely the importance and function of the "confession" heis Theos (God is one) in Judaism, the root meaning of the Greek word homologia and its cognates, certain syntactical criteria (homologein with hoti, the infinitive, or the double accusative), and the use of the noun homologia in the New Testament. The homologia was simple in form, its basic pattern including (1) the naming of Jesus, who lived and died in the course of history, and (2) the ascription to him of an important title or concept, which was descriptive of a more than ordinary nature and function, revealed particularly by the resurrection.

An early form of the homologia, most characteristic of the gospel and letters of John (e.g. Jn 9.22; I Jn 5.1), was "Jesus is the Christ." In the beginning the confession simply identified and acknowledged Jesus as the fulfillment of Israel's messianic hope (Mk 8.29; 14.61), but in the post-resurrection period it was broadened in meaning to include the suffering or death of Jesus and his resurrection. Other formulas expressing the death-resurrection motif (e.g. Lk 24.26,46; Acts 2.36; Rom 8.34; I Pet 3.18), if not forms of the homologia, at least illustrate this broadening of meaning. In the early church the confession of Jesus as the Christ was a personal declaration of faith (Mk 8.29; Jn 11.27; 20.31; I Jn 5.1). This became the core of the Christian proclamation which attempted to convince the Jews that Jesus was the promised Messiah (Acts 17.2-3). At other times the homologia was the test of personal belief and conviction before those who denied its content (Jn 9.22; I Jn 4.3, v.l.); it was expressed before hostile authorities (Mk 14.61-62; 15.2; I Tim 6.12-13; Acts 17.3,7) and it served a normative and polemical function against heretical movements (I Jn 2.18-23; 4.1-3; II Jn 9-11).

According to the letters of Paul the primitive Christian homologia was kyrios Jesus, "Jesus is Lord" (Rom 10.9; Phil 2.11; I Cor 12.3); the remainder of the New Testament does not significantly reflect this form (but see Acts 11.20). In the Aramaic-speaking Christian community Jesus was addressed as "Lord" (maranatha, I Cor 16.22), but it was among Gentile Christians that this confession was broadened and enriched in meaning to designate Jesus, the resurrected Lord, as the true kyrios among many, the Lord of every Christian, the Lord of the assembled congregation. This confession was utilized as an open declaration or acclamation in worship (Phil 2.5-11; cf. I Cor 12.3); it probably was used in connection with the rite of baptism (cf. Rom 10.9); and more certainly it formed the heart of the Christian proclamation (Rom 10.8-10; Acts 11.20; II Cor 4.5). The homologia also had an important function in times of controversy and persecution, when the Christian was called upon to acknowledge his loyalty (I Cor 12.3) or when the confession was a polemical declaration against Hellenistic polytheism and the Caesarcult (I Cor 8.5-6).

"Jesus is the Son of God" was a third form of the homologia, expressed most clearly in the gospel and letters of John (e.g. Jn 1.34; I Jn 4.15), but also occasionally elsewhere (Acts 9.20; Heb 4.14). Usually this confession expressed a variation of (Jn 1.34,49; Acts 9.20,22) or stood in apposition to (Mt 16.16; Mk 14.61; Jn 11.27; 20.31) the Christos-homologia, but ultimately it came to express concepts and convictions which the church gained in its developing life, that Jesus was the unique Son of the Father, that he had been with the Father from the beginning, that he was the mediator between God and man. In addition to the life-situations relative to the Christ-confession, the homologia "Jesus is the Son of God" was used in the rite of baptism (Acts 8.37; v.l.) and served the function of promoting or preserving faithfulness in time of difficulty and persecution (Heb 4.14; 10.23).

Microfilm $3.80; Xerox $13.30. 293 pages.

THE HERMENEUTICAL BASIS FOR LUTHER'S DOCTRINE OF LOVE FOR THE NEIGHBOR

(L. C. Card No. Mic 60-6698)

Donald Charles Ziemke, Th.D.
Princeton Theological Seminary, 1960

Problem

Modern hermeneutical scholarship has often appealed to Luther for support on the authority of the Bible, its central message and principles of interpretation. One such school, associated with Ebeling, is concerned with the Christological center of the Bible and Luther is often cited as supporting a radical Christocentricity combined with an existentialist conception of the purpose of hermeneutics. A reinvestigation of Luther's views was necessary.

Luther's doctrine of the neighbor was chosen for several

reasons. As a central feature of his ethics, it needed re-emphasis since it had not been discussed in recent years. In view of this a large portion of the dissertation was devoted to a detailed explanation of the foundations and meaning of the doctrine. In addition, the doctrine involved Luther's interpretation of the Decalog, the Old Testament and Natural Law. This meant that the meaning of the centrality of Christ would be tested with reference to the doctrines of creation, preservation and salvation.

Method

Two principal problems confronted the study, the exact definition of Luther's doctrine of love for the neighbor and the methods, which varied from period to period, Luther used to base this doctrine on the Bible. The doctrine received crystallized form in 1529 when Luther finished his two catechisms. Earlier, in 1512, Luther received the official commission of the Catholic Church to teach the Bible. Between 1512 and 1529 Luther formulated and reformulated his doctrine and experimented with different hermeneutics. The dissertation described this between 1512 and 1529.

Before Luther's own position was studied it was necessary to survey what love for the neighbor meant before Luther. The survey concentrated on Augustine, Aquinas and Nominalism (especially Jacques Lefevre d'Etaples).

Conclusions

The study found that Luther's hermeneutics with respect to love for the neighbor could only be understood in view of the doctrine of creation. The activity of Christ in creation and revelation in the Old Testament was crucial.

In the first period, 1512-1517, God was seen as the Augustinian summum bonum. Man's purpose in this world was to prevent the body and the allurements of the world from extinguishing the spark within and to reunite that spark with God. The neighbor was to be "used" (uti) for this end, and not "loved" (frui). In the second period, 1517-1521, Luther's Christological insight developed to obscure the difference between the Father and the Son. God was understood in terms of Christ. Man had meaning only as a member of the body of Christ; his purpose was to function as a member of that body for the welfare of other members. "The neighbor" meant a fellow Christian. In the third period, 1521-1529, God the creator was discovered. The creator had sent Christ, who was the foundation and agent in creation, for man's sins. Natural Law was written on men's hearts in creation but its meaning was obscured by man's fall. Only Christ could give the true meaning of Natural Law by summing it up in the double commandment of love, for God and the neighbor. Luther concluded that the decalog was binding on Christians only insofar as it was given by Christ in the Old Testament and was synonymous with Natural Law. The Bible was authoritative in ethics for today only as it agrees with Natural Law. Love for the neighbor, based on love for God, was the only possible course of action for all men as God's creatures. In practical terms it meant the Decalog which showed the way God had arranged the world to make his good gifts available to men.

Microfilm $2.75; Xerox $8.40. 184 pages.

SOCIAL PSYCHOLOGY

LEADER-FOLLOWER FRAME OF REFERENCE IN POLITICAL BEHAVIOR

(L. C. Card No. Mic 61-1714)

Jose Armilla, Ph.D.
University of Michigan, 1961

This exploratory study of political leaders and their followers was guided by the idea that the behavior of the leader can be understood only in terms of his relationship with the group he is leading. Limited aspects of this problem were investigated among precinct captains and their constituents in the Detroit Area who were interviewed immediately after the 1956 Presidential election.

The description of the precinct leader in this study utilized two major concepts: (1) active leadership, and (2) organizational effectiveness. Active leadership in the precinct means engaging fully in those actions required by the role: maintaining contact with those above him in the party organization, recruiting helpers and supervising their work during the campaign, and carrying out the administrative duties of the office such as canvassing and keeping records. A leadership score was given to the individual who performed any of these tasks and was used to distinguish the active from the less active leader.

Organizational effectiveness was defined in this study as the achievement of the organizational purpose in the precinct – maximizing the potential vote for the party at the polls and informing the electorate of the merits of the party's candidates and its stand on issues. A multiple-correlation analysis was used to estimate the vote in each precinct and utilized demographic characteristics – Catholicism, Negro, eighth grade education, and blue collar occupation – which were regarded as important determinants of voting turnout. The discrepancy between the estimated and actual vote was one measure of organizational effectiveness. In other words, this increase or decrease of the vote for the party could be attributed to the activities of the precinct leader.

A description was also made of the fit between the demographic characteristics of the leader and follower. The leader was compared with the modal follower on religion, nationality, occupation, and education. The factor of similarity between leader and follower was based on combinations of these categories. "Medium similarity" involved sharing in common either nationality or religion, but not occupation and education. "Extreme dissimilarity" included both religion and nationality in a disparity relation.

A comparison was done between the issue orientation

and ideology of the leader and his followers. The issues were government participation in medical care, foreign aid, and civil rights. The leaders were found to be closer to the party ideology than the members of the party cross section. In general, the Republican leaders took opposite stands from the Democrats in all issues. The question was asked whether or not similarity in issue orientation between the leader and his follower was a function of socio-economic status rather than party affiliation. Among Republicans, it was found that in precincts where leader and follower were likely to differ in status, there was a disagreement on issue position while in precincts where they could be equated in status, there was found to be more agreement.

The factors that made for active leadership were the following: (1) those who volunteered were more active than those who were recruited; (2) the veterans of 1932 and 1948 campaigns were more active than the relative newcomers; (3) those who belonged to seven or more non-political groups were more active than those who claimed membership in one or two groups; (4) active leaders were more likely to be found in "medium similarity" precincts than in "extreme dissimilarity" precincts.

The leadership activities of the Republicans were significantly related to the vote for the party, while those of the Democrats were not related at all.

Medium similarity between the characteristics of the leader and follower tended to help the Republican leader in maximizing the vote for the party. In extreme dissimilarity, the Republicans tended to lose votes.

In the case of the Democrats, the party gained votes regardless of the similarity relation between leader and follower. The party was supported by voters in precincts having "extreme dissimilarity" as well as "exact similarity." It was suggested that a combination of factors other than precinct leadership would maximize the potential Democratic vote in Detroit; namely, labor unions, membership in nationality groups, Negroes, a popular governor. In the case of the Republican minority, the precinct captain provided the necessary support for the Republican voters who were exposed to fewer group pressures.

On the basis of the present study, some suggestions may be given for further descriptions of party organization at the precinct level. To observe the maximum influence of party organization on the voting turnout, one might study local elections in non-presidential years. To minimize influences other than active leadership, one might study leader-follower contacts on the individual level within a homogeneous area, for example, white collar precincts. To ascertain whether mechanical propaganda or personal influence is the dominant style of campaigning, one might examine "extreme dissimilarity" precincts as contrasted to "medium similarity" precincts. One suspects that the leader would resort to mechanical propaganda in areas where he differs very much from his constituents in demographic characteristics.

Microfilm $2.75; Xerox $4.20. 78 pages.

THE EFFECTS OF CLIENT SOCIAL CLASS, SOCIAL CLASS DISTANCE, AND SOCIAL WORK EXPERIENCE ON THE JUDGMENTS OF SOCIAL WORK STUDENTS.

(L. C. Card No. Mic 61-1397)

Joseph Scott Briar, D.S.W.
Columbia University, 1961

This research had two objectives. One was to study the application of the predictive behavior approach to research on judgment in social work practice. The second objective was to test the following hypotheses:

Hypothesis I: Social work students will make significantly different judgments when different social class status characteristics are ascribed to the client.

Hypothesis II: The degree of similarity the student social worker assumes to exist between himself and the client will be inversely related to the distance between the client's social class status and the social work student's class background.

Hypothesis III: Variance in the judgments made by social work students about the same client will tend to decrease as the students' previous experience in social work increases.

The sample consisted of 130 social work students. Each student was randomly assigned, without his knowledge, to one of two experimental groups. Both groups were given descriptive material about two clients. When presented to experimental group I, middle class occupational and educational characteristics were ascribed to the first client and lower class characteristics were attributed to the second; for experimental group II, the ascription of middle and lower class characteristics to the two clients was reversed. The students predicted the responses of each client on a self concept check-list and two attitude scales, acceptance of authority and traditional family ideology. In addition, the students rated each client on a clinical judgment inventory. To measure assumed similarity, the student's self-responses were obtained on the self concept and attitude instruments.

Hypothesis I was supported by the study findings. Both clients were judged to have significantly more managerial, autocratic, narcissistic and competitive self concepts when middle rather than lower social class characteristics were ascribed to them. When lower class information was given, both clients were judged to have significantly more submissive attitudes to authority and more traditional attitudes toward family life than when middle class information was given. No consistent differences were found on the clinical judgment inventory as a function of client social class; however, this instrument also failed to discriminate between the two dissimilar clients used in the study.

Although hypothesis II was not supported, the findings did reveal a consistent tendency for the students to assume greater similarity between themselves and the client when middle rather than lower social class characteristics were ascribed.

Hypothesis III was not supported by the study findings.

In addition to the finding that social work students are attuned to perceive clients differently as a function of their social class status, evidence was found to suggest that the effect of client social class on judgment may vary in

relation to three factors: (a) the personality characteristics of the client; (b) the kinds of judgments the student is asked to make; and (c) the amount of relevant information available to the judge in relation to the specific judgment tasks that confront him.

The research implications of the findings include the need for research on the interaction of social class and personality information on judgment and on the process by which the judges weight different kinds and amounts of information. Microfilm $2.75; Xerox $8.60. 189 pages.

THE SELF-CONCEPTS OF ALCOHOLICS

(L. C. Card No. Mic 61-2097)

Ralph Gordon Connor, Ph.D.
University of Washington, 1961

Chairman: Robert E. L. Faris

A study to measure the self-concepts of alcoholics using role theory as its theoretical orientation and the adjective check list developed by Harrison Gough as the principal tool of investigation.

Many investigators have sought to characterize the personalities of alcoholics but there is no uniformity in their findings, no indications are given as to the importance in a given personality of the traits they describe, and no estimate is made of the prevalence of these traits in the general population. These investigations have been made mainly from psychiatric or psychoanalytic orientations which presume that the behavior observed is the result of pre-existing psychopathology, and the object of these investigations was to uncover patterns of psychopathology to which the alcoholism could be attributed.

Role theory, which regards personality as "action systems arising out of the interplay of self and role," does not require the assumption of pre-existing personality traits which eventuate in alcoholism, but it does predict that if there is anything characteristic in the personality organization of alcoholics which precedes alcoholism it must reside in the self, and that any characteristic elements of personality which might follow from the alcoholic experience would involve the self from the interplay of self and role. Thus, since the self is reflected in the self-concept, any uniform, differentiating characteristics in the personalities of alcoholics should be evidence in their self-descriptions.

Using the adjective check list developed by Harrison Gough at Berkeley and an extensive questionnaire on social background and drinking history, this study gathered data from 387 alcoholics; 114 male and 39 female members of Alcoholics Anonymous; 106 jailed alcoholics (mostly skid roaders); 102 alcoholic inmates of three prisons; and 25 former patients of an alcoholic sanatarium.

Data were also gathered from a "comparison group" of 230 extension classes' students at the University of Washington. The adjectives checked by these two groups were then tabulated and compared for the various sub-groupings employed by the study.

It was found that five characteristics stand out in the self-descriptions of alcoholics. First, they describe themselves predominantly in terms of qualities that would make them liked and accepted in primary group relations; second, their self-descriptions are much less extended and homogeneous than those of non-alcoholics; third, there is a virtual absence in their self-descriptions of the secondary relationship terms which constitute most of the self-descriptions of non-alcoholics; fourth, there is a distinctly neurotic aspect to their self-descriptions; and fifth, they are much less "self-accepting" in their self-descriptions than non-alcoholics.

It was also found that the self-descriptions of the several alcoholic sub-populations differed in extensiveness, and the use of secondary relationship terms, in a clear gradient from sanatarium patients, whose self-descriptions most resembled those of non-alcoholics, to skid roaders whose self-descriptions least resembled them.

Finally, it was found that the self-concepts of alcoholics shifted with lengthening sobriety until, between three and seven years of sobriety, all but one of the differences found had declined to insignificance. The aspect of the self-descriptions of alcoholics which remained unchanged was the emphasis on primary relationship qualities.

In conclusion, it was suggested that the five characteristic differences found actually comprised two major themes in the alcoholic personality. Because of its stability and clarity, the primary relationship aspect was identified as one, and it was suggested that the remaining four actually represented, together, a generalized lack of integration and organization of the self.

Microfilm $2.75; Xerox $8.20. 179 pages.

ACHIEVEMENT MOTIVATION AND OCCUPATIONAL MOBILITY IN THE UNITED STATES

(L. C. Card No. Mic 61-1734)

Harry Jennings Crockett, Jr., Ph.D.
University of Michigan, 1961

This study examines the influence of strength of achievement motivation on intergeneration occupational mobility in the United States. A theory of achievement motivation which has been developed in experimental settings provides the basis for expecting that persons highly motivated to achieve will manifest more effort and persistence in the attempt to rise in the occupational hierarchy than those who are less strongly motivated to achieve. Secondary analysis of findings of previous research demonstrates that Americans from all social strata commonly perceive occupations as falling along a continum of prestige and difficulty of attainment. This relationship between apparent difficulty of a task and incentive value (prestige accorded) is the distinguishing feature of domains for which the theory of achievement motivation is directly relevant.

The hypotheses tested are: strength of achievement motivation among persons sharing equal opportunity should be positively associated with upward occupational mobility and negatively associated with downward occupational mobility.

The study sample of adult males not reared on farms (N = 368) is obtained from a national sample survey (Gurin, et al., 1960). Stories told in response to pictures (the thematic apperceptive method) provide the measure of

strength of achievement motivation. Prestige scores are reliably assigned to occupations of respondents and their fathers by the writer according to prestige ranks empirically established by previous research (National Opinion Research Center, 1953). Four occupational prestige categories are constituted. This allows measurement of intergenerational occupational mobility in the occupational prestige system.

Results for men reared in the two lower prestige categories, who constitute two-thirds of the study sample and of the nation's labor force, support the prediction that strength of achievement motivation is positively associated with upward occupational mobility. The results remain, although at somewhat reduced levels of statistical significance, when two sets of variables of known importance to mobility are controlled by precision matching in smaller subsamples: (a) occupational prestige category of origin, education level, and age; and (b) age, marital status, and the presence of children in the home. When only those respondents are considered for whom the coding of prestige of occupation is most precise, results for men reared in the two lower prestige categories are highly significant.

The hypothesis concerning achievement motivation and upward mobility is not supported for persons who were reared in the two higher prestige categories.

The hypothesis concerning achievement motivation and downward mobility is not supported.

The absence of predicted relationships among persons reared in the two higher prestige categories is related to the fact that attainment of some college education (which virtually guarantees high occupational status) is as frequent among respondents low in achievement motivation as among those high in achievement motivation from high prestige backgrounds. The high frequency of college education among those low in achievement motivation in these groups is attributed to other factors associated with social class background.

Two other social motives -- power motivation and affiliative motivation -- are found, in general, to be unrelated to occupational mobility. However, strength of affiliative motivation is significantly related to upward mobility among persons reared in the Upper Middle prestige category. This result supports recent theoretical arguments concerning the increasing importance of cooperative, interpersonal skills in the successful pursuit of high status in bureaucratic settings.

The present study is the first to provide empirical evidence that strength of achievement motivation assessed by thematic apperception is an important personality factor contributing to occupational mobility. The study illustrates the potential fruitfulness of simultaneous consideration of individual personality variables and social structural variables in the analysis of social mobility.

Microfilm $2.95; Xerox $10.15. 225 pages.

ATTITUDES TOWARDS DESEGREGATION AMONG SOUTHERN STUDENTS ON A NORTHERN CAMPUS

(L. C. Card No. Mic 61-2210)

Elizabeth Marie Eddy, Ph.D.
Columbia University, 1961

This study investigated attitudes towards integration among 184 Southern (primarily urban and upper-class) male freshmen and seniors in a large Northeastern Ivy League College. A control group comprised 190 Northern undergraduates. All Southerners were born and completely educated in the District of Columbia or in one of the seventeen states in which segregation was law prior to 1954. Inquiry was directed towards the relationship between attitudes and length of time in the North. A questionnaire was designed to elicit these attitudes.

The student's written replies to the questionnaire were analyzed according to the student's year in college and regional origin with the following significant results: (1) Deep South seniors were more liberal than freshmen in attitudes towards school desegregation and integration in Northern public housing. (2) Border State seniors approved the Supreme Court decision more intensely than freshmen; they were more apt than freshmen to adopt the positions of either strongly favoring or being opposed to integration in the Northern church. (3) There were no differences between Northern and Border State freshmen in attitudes towards elementary school desegregation; Border State seniors were less liberal than Northern seniors. (4) Northern freshmen were more liberal than Border State freshmen in attitudes towards the Court decision, integration in Northern and Southern private apartment buildings and community social activities and Northern residential areas. These questions did not discriminate between seniors from the two regions. (5) Deep South freshmen and seniors were less liberal than Northern and Border students in attitudes towards desegregation of elementary schools and the Court decision; they were less liberal than Northerners towards high school desegregation and integration of Northern colleges and community social activities in the North and South. Deep South freshmen were less liberal than Northern freshmen in attitudes towards Northern church integration and integration in Northern and Southern housing.

Significant relationships between other variables and attitudes towards desegregation were as follows: (1) Deep South respondents whose fathers' annual income was under $10,000 were more liberal than those whose fathers earned $10,000 or more in their attitudes towards integration of schools and integration in the Northern and Southern community. (2) Deep South students whose fathers were employed in white and blue collar occupations were more favorable than the sons of professionals and business executives in attitudes towards integration in the Northern and Southern community. (3) Deep South students intending to remain in the North after college were more liberal towards school desegregation than those planning to return to the South. (4) Border State students whose three best friends were non-Southern were more liberal towards school desegregation than those having Southern friends. (5) Border State students who participated in extra-curricular activities were more liberal than non-participants in their attitudes towards integration in the Southern community.

Microfilm $2.75; Xerox $8.80. 191 pages.

SOME SMALL GROUP RESEARCH VARIABLES AND INTERACTION IN THE MARITAL DYAD AS REPORTED BY 120 COLLEGE-EDUCATED COUPLES

(L. C. Card No. Mic 61-1836)

Charles Henry Elliott, Jr., Ph.D.
Cornell University, 1960

The purpose of this research is to test certain small group findings as these findings apply to the study of interaction in the marital dyad. Seven small group findings previously reported in the social psychological literature --involving the variables role differentiation, need similarity-dissimilarity, and unity--are tested in the context of the marital dyad.

Data for the study were obtained from a sample of 120 college-educated couples. The instrument was a structured questionnaire. An index of role differentiation was developed from husband and wife responses to questions dealing with the allocation of decision-making responsibility in home management, money management, and leisure time planning. Unity was indexed by questions pertaining to: satisfaction reported with the way decisions were made, the degree of satisfaction associated with the thoroughness of discussions of serious matters, and the degree of interspousal confidence expressed. Next similarity was operationalized as the difference between husband and wife self-ratings on a series of 11 need statements.

The following results were obtained:

1. Both husbands and wives report that the wife "gets emotional" and "gets feelings hurt" more frequently than the husband. The husband more often than the wife "clarifies the issue" and "makes the final decision." This is interpreted as evidence of the role differentiation into expressive and instrumental behaviors in the H-W dyad known to occur in small, problem-solving groups.

2. A significant linear relationship was found between the number of children reported and the degree of task-oriented role differentiation in the H-W dyad. This parallels small group findings that increases in functional problems are associated with greater task-oriented role differentiation.

3. A negative relationship exists between the degree of task-oriented role differentiation and the degree of unity in the H-W dyad. This parallels the small group finding that high task-oriented role differentiation is associated with less solidary relationships.

4. No relationship was found between the degree of dominance and the frequency with which the dominant spouse reports gentle and self-effacing means in decision-making discussions. The results do not parallel evidence reported in dyadic interaction in the small, experimental group context, probably because the withdrawal of marital partners is not feasible.

5. Unity in the H-W dyad is positively associated with frequency of inter-spousal consultations prior to making decisions. This finding is interpreted as parallel to the small group finding that strong feelings of attraction or liking induce a strain toward similarity of opinion with respect to matters of co-orientation between two persons.

6. A direct relationship exists between the degree of unity in the H-W dyad and objective similarity of opinions. This parallels small group findings indicating that similarity of opinions increases with attraction.

7. No relationship exists between the extent of need-similarity and unity in the H-W dyad. The results are interpreted as indicating that long-term commitments involving constraint to the interactive relationship (in the H-W dyad) decrease the significance of need-similarity as a factor in group unity.

The over-all findings reveal the utility of considering the H-W dyad as a small group phenomenon. Many processes that occur within the context of the short-term experimental group also occur in husband-wife interaction.

Microfilm $2.75; Xerox $7.20. 153 pages.

PREVENTION OF POSTPARTUM EMOTIONAL DIFFICULTIES

(L. C. Card No. Mic 61-1403)

Richard Edwards Gordon, Ph.D.
Columbia University, 1961

This study has measured the mental health effectiveness, through classroom preparation of expectant mothers, of systematic instruction in preventing postpartum emotional difficulties. After analysis of items that discriminated between normal and emotionally upset new mothers a set of instructions was developed which suggested means of coping with and minimizing the problems associated with social and psychological reorganization in new parents' lives.

The fundamental hypotheses were:

1) Background and recent history items related to preparation for the role of motherhood in a social history questionnaire, administered soon after parturition, are correlated with postpartum emotional difficulties;

2) Verbal instructions regarding methods of social and psychological preparation for maternity, including emphasis upon assistance by individuals with ability to instruct, assist, and encourage new mothers, will influence them to change their behavior in the recommended direction, and thus diminish the tendency to emotional difficulty;

3) Quantitatively, the greater the net change of plans and preparation in the suggested direction, the less is the tendency to emotional difficulty.

Each of these hypotheses was tested in the experiment.

Altogether 465 new and expectant mothers at the Englewood Hospital participated in experimental, control, and comparison groups. Only private, mostly middle class, patients were used. Their obstetricians and the Public Health Nurses at the hospital served as judges of their emotional states by ratings on a four-point scale six weeks and six months after delivery. Antenatal class subjects, controls and experimentals, filled in a background personal history questionnaire before the experiment and a follow-up questionnaire soon after delivery. These questionnaires provided background history scores and a measure of any change. Community group subjects, who did not attend antenatal classes, filled in only one background history questionnaire after delivery.

Experimental subjects attended classes in two main groups, either with their husbands or alone. Both groups received two classroom sessions of the same systematic social-psychological instructions. Randomly selected antenatal classes with comparable subjects received

similar standard antenatal class baby care information, but no psychological instruction.

All of the hypotheses were verified. The experimentally instructed classes reported change in the instructed direction significantly more than controls. There was a high correlation between amount of instruction and reported change in social situation. The amount of instruction was highly correlated with subsequent emotional state, as was amount of change in the suggested direction and subsequent emotional state.

The results and conclusions were discussed in relation to their limitations and implications for psychology in general, for prevention and psychotherapy, and for sociology. Future research might include not only continued study of expectant and new mothers but also preparation of other groups entering "transition stages" in life for their new roles and responsibilities. Extensions of research were described to test a more quantitative hypothesis regarding the importance of social and psychological factors in emotional disorder.

Microfilm $2.75; Xerox $5.60. 113 pages.

AN EVALUATION OF THE SOCIOLOGICAL, PSYCHOLOGICAL, AND PHYSIOLOGICAL POST-TREATMENT ADJUSTMENT OF MENTAL PATIENTS TREATED WITH REGRESSIVE ELECTRIC SHOCK THERAPY.

(L. C. Card No. Mic 60-3529)

Nathan Gary Mandel, Ph.D.
University of Minnesota, 1960

This study was an evaluation of the effects of Regressive Electric Shock Therapy (REST) as it affects the post-treatment sociological, psychological, and physiological adjustment of psychiatric patients. REST consists of the transcranial electrical production of several grand mal seizures daily until neurological signs and behavioral symptoms indicate that the patient has regressed to an infantile level of functioning. Earlier studies indicated the salutory effects of REST upon patients who had been refractory to other forms of psychiatric therapy. The following hypotheses were tested for significance of component variables.

1. A significant relationship exists between sociological adjustment and age, environment, social participation, marital status, sex, religious activity, length of hospitalization, and chronicity of illness.
2. A significant relationship exists between psychological adjustment and personality, intelligence, mental status, behavior, and extensity-intensity of follow-up treatment.
3. A significant relationship exists between physiological adjustment and number of ECT during REST, patient's opinion of general and physical health, electroenaphalographic status, electrocardiographic status, weight changes, and diagnosis.

The study sample consisted of sixty-seven patients treated with REST at the University of Minnesota Hospitals between 1955 and 1957, who were at least one year post-treatment on August 1, 1958.

Patients were classified as improved and unimproved, and the two groups frequency matched for pre-REST diagnosis, number of ECT during REST, duration of illness prior to REST, pre-REST social participation, pre-REST opinion of health, time from treatment to study, time on hospital psychiatric stations during treatment, pre-REST MMPI scores, and extensity-intensity of follow-up treatment.

Patients were admitted to University Hospitals for a twenty-four hour period of evaluation. This consisted of the following procedures:

1. Sociological
   a. Chapin Social Participation Rating Scale
   b. Mandel Social Adjustment Rating Scale
   c. Environmental Q-sort Rating
   d. Interview with patient regarding: 1) Residence Stability, area, and situation. 2) Religion and religious activity. 3) Appraisal of physical and general health. 4) Marital status and family data. 5) Occupation and economic status. 6) Education. 7) Major life changes. 8) Psychiatric treatment history.
   e. Interview with relatives for data patient was unable to supply and for patient's general adjustment appraisal from the relatives viewpoint.
   f. In addition to the forgoing a complete hospital chart search was made to determine the following: 1) Diagnostic data. 2) Psychological testing data. 3) Treatment and illness history. 4) REST data. 5) Electroencephalographic and electrocardiographic examination prior to REST. 6) Identifying and general information. 7) Patient's life history. 8) Clearance with State of Minnesota Department of Public Welfare Central Registration Bureau was made to determine post-treatment institutional and social agency contacts.
2. Psychological
   a) Mental Status Examination
   b) Minnesota Multiphasic Personality Inventory
   c) Wechsler Adult Intelligence Scale
   d) Behavior Q-sort Rating
3. Physiological
   a) Physical Examination
   b) Neurological Examination
   c) Electroencephalogram
   d) Electrocardiogram
   e) Extensity-Intensity Treatment Q-sort Rating

The improved and unimproved group were compared on the variables contained in the hypotheses and were tested for significant differences at the 5 percent level of confidence with Students t and Chi Square statistics.

1. All variables in hypothesis 1 are found to be significant except sex, religious activity, length of hospitalization, and duration of illness. In hypothesis 2, the non-significant variable was extensity-intensity of follow-up treatment.

The number of ECT during REST, weight changes and diagnosis were found to be not significant in hypothesis 3.

2. REST patients maintain the beneficial effects of treatment longer than patients not so treated as evidenced by comparison with other patient groups of like description.

3. Patients who derived greatest benefit from REST were found to be from 28-50 years of age, intelligence above IQ of 110, duration of illness above five years, educational achievement at the college level, good physical health as well as a self-concept of being physically healthy, diagnosis of pseudo-neurotic (chronic-undifferentiated) or paranoid schizophrenia, extensively exposed and refractory to a wide variety of other psychiatric therapies prior to REST, and who prior to REST had experienced a significant degree of success or satisfaction in occupation, education, family life, group activities and interpersonal relationships. Microfilm $2.75; Xerox $9.45. 207 pages.

MINORITY GROUP IDENTIFICATION AND INTERGROUP RELATIONS: A STUDY OF JEWISH IDENTIFICATION AND ITS RELATIONSHIP TO OUTGROUP ATTITUDES AND ASSOCIATIONS IN A SAMPLE OF MINORITY GROUP ADOLESCENTS.

(L. C. Card No. Mic 61-1415)

Jack Rothman, Ph.D.
Columbia University, 1961

This project had to do with minority group adjustment and specifically with the relationship of minority group identification to outgroup attitudes and associations. One line of thought prevalent in the social sciences, and associated closely with Kurt Lewin, holds that the development of ingroup identification provides the minority group member with a sense of psychic security on the basis of which he will form firm, positive relationships with the outgroup. The hypothesis which was projected in this study suggested that there is no direct relationship between ingroup identification and outgroup relatedness. The outgroup orientation of a minority group member is influenced by many factors -- his psychic security; the family situation in infancy and childhood; the specific outgroup attitudes held and communicated by the parents; concrete experiences with the outgroup; attitudes of peers; the intergroup climate in the community of residence; sense of identification with the minority ingroup; etc. The factor of minority group identification is not seen as being the chief and determining variable. Accordingly, it was hypothesized that the correlation between ingroup identification and outgroup attitudes and associations upon empirical testing would show up as negligible.

The heart of the project, then, consisted of an experimental study designed to test this hypothesis. Leading up to the experimental work was a rather thorough theoretical development which covered the following areas:

The concept of identification from the psychological and social standpoints.
Reference group theory.
The definition of minority group identification based on reference group theory.
Possible types of reaction to minority group status.
An analysis and critique of the Lewin theoretical formulation.
An elaboration of the major assumptions upon which the proposed hypothesis rested.

Regarding the experimental design, work was confined to the Jewish minority group and to the adolescent age level. The design consisted of testing a sample of subjects with an instrument which measured Jewish identification and at the same time with scales which gauged outgroup attitudes and outgroup associations. The Jewish Identification Scale was based on interest in Jewish cultural life, and through various empirical procedures was found to manifest adequate validity and reliability. Outgroup attitudes were measured through use of Fishman's Scale of Needed American Improvements, which indicates the degree of acceptance of negative stereotypes concerning the majority of Americans. Outgroup associations were gauged through an adaptation of Chapin's Social Participation Scale. This adaptation, the Outgroup-Ingroup Participation Index, indicates the degree to which a Jewish individual participates in groups which are all or mostly Jewish and which are under Jewish sponsorship.

The sample consisted of adolescent members of the B'nai B'rith Youth Organization, Long Island Region. This sample was made up of young people who were identifiable and accessible as Jews and manifested a considerable range of variation in the attribute of Jewish Identification. At the same time, the sample did not include totally non-identified Jews. Through specified criteria twelve groups of subjects were selected and tested. The final sample was made up of 189 middle-class subjects with an approximately equal number of males and females and an equal number of residents of areas of high and low Jewish population concentration.

Upon computation of correlation coefficients it was found that there were negligible correlations among the variables of the study, and further that there was no consistent direction of correlation.

In concluding the study, certain implications were drawn for agencies dedicated to the well-being of minority groups. In addition, sociological implications and consequences of a strong ingroup position were pointed out.

Microfilm $3.60 Xerox $12.60. 278 pages.

SITUATIONAL DETERMINANTS OF THE EXPRESSION OF ACHIEVEMENT MOTIVATION IN THEMATIC APPERCEPTION

(L. C. Card No. Mic 61-1789)

Charles Philip Smith, Ph.D.
University of Michigan, 1961

This experiment is designed to investigate two alternative theoretical positions: that of McClelland and Atkinson who assume that "achievement imagery" in thematic apperception reflects only achievement motivation, and an alternative position that under certain conditions "achievement imagery" may reflect extrinsic motivation (i.e., motivation for goals other than pride in accomplishment).

Hypotheses are: (1) n Achievement scores obtained following experimental orientation toward extrinsic goals

are expected to be higher than under Neutral conditions on the basis of the alternative position but not the McClelland-Atkinson position. (2) A positive relationship is expected between n Achievement scores and arithmetic performance when both are obtained under Extrinsic orientation on the basis of the alternative position, but not the McClelland-Atkinson position. Supplementary hypotheses specify relationships between Test Anxiety and arithmetic performance and between n Achievement, Test Anxiety, and level of aspiration.

Subjects were 215 male introductory psychology students. Approximately 30 subjects were assigned to each of seven experimental conditions. Four types of orientation were employed to arouse motivation for performance of an arithmetic task: Achievement ("test measures ability"), Multi-Incentive (achievement orientation plus monetary prize and proctoring by experimenter), Extrinsic (pressure to finish task in order to leave late experimental session for evening meal), and Relaxed (low-motivation control condition). In Conditions "A" a thematic apperceptive measure, administered under Neutral conditions, preceded arithmetic performance under each orientation. In Conditions "B" the projective measure immediately followed performance under Achievement, Multi-Incentive, and Extrinsic orientations. Self-report data from a post-performance questionnaire provided an independent estimate of the effectiveness of the manipulations.

Slightly, but not significantly, higher n Achievement scores were produced under Achievement and Multi-Incentive orientation than under Neutral conditions, a difference in the direction expected from the McClelland-Atkinson position. However, the significantly higher n Achievement scores produced under Extrinsic orientation are not expected from the McClelland-Atkinson assumption but support the contention that "achievement imagery" may reflect extrinsic motivation. This result seems not to be due to unintentionally introduced achievement incentives since self-report data indicate that achievement incentives were relatively weak in the Extrinsic Condition.

N Achievement-performance results are equivocal. With quantitative ability controlled, no performance differences between high and low n Achievement groups within particular conditions are significant. However, the pattern of results is as expected from the McClelland-Atkinson position when conditions are ordered according to self-report data concerning the incentives perceived in different conditions. The positive relationship between n Achievement and performance is strongest when achievement incentives account for the greatest proportion of over-all motivation aroused for performance. With subjects simultaneously classified in terms of n Achievement and Test Anxiety the relationship between achievement-related motivation and performance is generally strengthened in the direction expected from the McClelland-Atkinson position. Performance results do not support the alternative position. There is no positive relationship between n Achievement scores and performance when both are obtained under Extrinsic orientation.

Results concerning achievement-related motivation and level of aspiration replicate previous findings only when the task is administered under relatively relaxed conditions. Under these conditions high n Achievement-low Test Anxiety subjects prefer tasks of intermediate difficulty significantly more often than low n Achievement-high Test Anxiety subjects, but not when the task is preceded by instructions or an activity likely to influence motivation.

The results strongly suggest that under certain conditions thematic apperceptive n Achievement scores may reflect extrinsic motivation. The need for standardized conditions for obtaining optimally valid n Achievement scores is emphasized. An implication is that "achievement imagery" in literary products with unknown eliciting conditions may reflect motivation for goals other than pride in accomplishment.

Microfilm $3.70; Xerox $13.05. 288 pages.

INTERGENERATIONAL TRANSMISSION OF MOTIVES

(L. C. Card No. Mic 61-1794)

Suresh Chandra Srivastva, Ph.D.
University of Michigan, 1961

The present research tested the following hypotheses based on the notion that needs are transmitted to children via certain socialization techniques used by parents within the family setting:

1. Parents with high need power would tend to use strong patterns of enforcements, make later demands on independence and develop high need affiliation among their boys.
2. Parents with high need achievement would tend to use mild patterns of enforcement, make earlier demands on independence and develop high need achievement among their boys.
3. Parents with high need affiliation would tend to use weak patterns of enforcement, be indistinguishable in the timing of demands on independence from the parents with low need affiliation and develop high need power among their boys.

To test these propositions 136 father, mother, and boy triads were selected from a larger project of the Institute for Social Research. Each of the respondents was interviewed and administered the TAT need measures developed by Veroff and others. The sample included delinquents and non-delinquents.

The following conclusions can be drawn from the present research:

1. the transmission or development of high need achievement remains unclear.
2. the transmission of need affiliation was theorized as impossible, but evidenced in parents of repeater delinquents, and where boys model after their fathers.
3. the transmission of high need power was theorized as impossible and such transmission was not evidenced.
4. among boys who were repeater delinquents, fathers with high need achievement had boys with low need achievement.

5. among boys who were emotionally dependent on their mothers, mothers with high need affiliation had boys with low need power.
6. among fathers having unskilled occupations, those high in need power made earlier demands on independence than those low in need power.
7. among mothers, with husbands in unskilled occupations, those high in need achievement made earlier demands on independence than those low in need achievement.
8. among mothers, with husbands in white collar occupations, those high in need power made later demands on independence than those low in need power.
9. mothers with high need affiliation utilized mild, rather than strong or weak, patterns of enforcement.
10. boys with low need achievement tended to have been exposed to mild, rather than strong or weak, patterns of enforcement by their mothers.

Several questions were raised about the problems of measurement methodology which are particularly relevant since several related studies on needs adopted different indexes in the same topical areas.

Also, since the obtained significant relationships existed only under conditions of certain control variables such as modeling, emotional dependence, delinquency or occupational status, it appears that theory in this area will have to take such parameters into account.

In general one must conclude from the present research that there are not yet any clear or simple answers to such questions as: What conditions influence the development of particular motives? or How do motives influence socialization practices? The role of boys' delinquency in this pattern of events remains an interesting enigma. However, it cannot be concluded that child rearing practices are altogether unpredictable from motives of parents, or that child rearing practices have no effect on the development of motives among children. The results of this research definitely point out that the mechanism of intergenerational transmission of needs is clearly influenced by a number of factors and the strength of family conditions varies with the nature of a large constellation of variables. One can clearly still conjecture that there is some relationship between parental patterns of child rearing and the development of needs among children, but the critical points in timing, the nature of sex differences, and the contribution of other variables to the interactive pattern still needs to be pinpointed and clarified.

Microfilm $2.75; Xerox $7.20. 151 pages.

SOCIOLOGY

SOCIOLOGY, GENERAL

AN ANTHROPOLOGICAL APPROACH TO ADMINISTRATIVE CHANGE: THE INTRODUCTION OF A GUIDANCE PROGRAM IN A HIGH SCHOOL.

(L. C. Card No. Mic 60-5080)

Mark S. Atwood, Ph.D.
Columbia University, 1960

A third listing. For abstract please see page 3586.

Microfilm $4.95; Xerox $17.55. 387 pages.

SOCIOLOGICAL CORRELATES OF NEONATAL AND POSTNEONATAL MORTALITY IN THE UNITED STATES: 1949-1951.

(L. C. Card No. Mic 60-5222)

Leona Leatrice Davis, Ph.D.
The University of Connecticut, 1960

The concept of infant mortality has, in recent years, been altered by an important medical development: markedly greater success in control over postneonatal deaths than in control over neonatal deaths. This, coupled with the fact that the etiologies of neonatal and postneonatal mortality differ considerably, has had two results: a general tendency to regard the two components of infant mortality as distinct entities and an increasing emphasis on the need for a better understanding of neonatal mortality. These considerations have a basis in the medical orientation to infant mortality; they reflect the physician's concern with the prevention of infant deaths.

Infant mortality may also, however, be considered from the point of view of its sociological manifestations. There are two questions to be considered in this context: (1) Are neonatal and postneonatal mortality sociologically, as well as etiologically, distinct? (2) If they are sociologically distinct, which of the two components exhibits the greater sensitivity to variations in social phenomena?

This study has attempted to answer these questions through correlational analysis. Using the neonatal and postneonatal mortality rates as dependent variables, correlation coefficients were calculated to determine their comparative degrees of association with three groups of independent sociological variables: (1) demographic indices, including: crude birth rate and per cent nonwhite population; (2) medical resources indices, including: per cent live births delivered, respectively, in hospital and by midwife; and (3) socioeconomic indices, including: median years of school completed, median family income, and farm-operator family level-of-living index. Units of analysis were State Economic Areas of the United States grouped according to region and metropolitan-nonmetropolitan residence. Primary sources of data were United States Bureau of the Census and United States National Office of

Vital Statistics publications for the years 1949, 1950, and 1951.

A detailed analysis was made of the correlations with each independent variable, and certain patterns were found to emerge. The postneonatal mortality rate was seen to be the more significant correlate of the independent variables under study. Not only was there a greater number of significant correlations with this component of infant mortality, but, further, the level of significance of the obtained correlations was generally higher for the postneonatal than for the neonatal mortality rate.

When the region-residence categories were placed into three divisions according to the level of their infant mortality experience, a number of regularities were noted. Regions of low infant mortality showed decidedly fewer significant correlations between dependent and independent variables than did regions of medium and high infant mortality. Most significant correlations were concentrated in regions of medium and high infant mortality. In some cases, metropolitan-nonmetropolitan residence was seen to cut across the infant mortality level categories; for some variables, significant correlations were concentrated almost entirely in the nonmetropolitan regions, irrespective of infant mortality level.

It was concluded that, in terms of the independent variables under consideration here, sociological variations in infant mortality are manifest in: (1) postneonatal mortality to a greater extent than, though not to be the exclusion of, neonatal mortality; and (2) regions with medium and high infant mortality experience to a greater extent than, though not to the exclusion of, regions with low infant mortality experience. Both medical and sociological considerations contribute tc a more productive understanding of the phenomenon of infant mortality.

Microfilm $2.75; Xerox $7.40. 159 pages.

DEMOCRACY IN DETROIT

(L. C. Card No. Mic 61-1740)

Irwin Goldberg, Ph.D.
University of Michigan, 1961

This dissertation was devoted to the exploration and evaluation of the political characteristics of Detroit's population and to the assessment of certain aspects of democratic theory. A model of the ideal distribution of primary political qualities was established, based on contemporary social system theory. The distributions actually found in Detroit were compared with the ideal and conclusions drawn as to the deficiencies of that population. This theory was subjected to critical examination by comparing it with traditional individualistic liberal democratic theory. The extent to which each theory correctly assessed relationships among political and social characteristics was ascertained. Finally, objective conditions of the social structure which affect the distribution of the primary political qualities were analyzed.

The contemporary theory used was a modified version of a model proposed by Bernard Berelson. Our formulation was: a healthy, well functioning political democracy is one in which, as a minimum requirement, there exist closely similar, approximately normal, distributions of the four major political dimensions in each class. The four dimensions are: stability-flexibility (in political party choice), acceptance-rejection (of elected and appointed governmental representation), progressivism-conservatism, and involvement-withdrawal (political participation).

Whereas the social system theory holds that the citizens of a democracy should differ in their political behavior and perspectives (some being involved in politics, others withdrawn; some being consistent party adherents, others showing no party attachment), traditional theory holds that each citizen should ideally be similar in these qualities. He should be flexible, progressive, involved and accepting.

The social system criteria were applied to a representative sample of the population of Metropolitan Detroit using data gathered by the University of Michigan's Detroit Area Study. In the case of each of the dimensions two classes had a distribution which was skewed from what it should have been in terms of the model; these were the lower working and upper middle classes. The former was deficient in that it had an excess of those qualities derogated by traditional theory; the latter had an excess of those qualities valued by traditional theory.

In assessing traditional theory, there were two major findings. 1) The four political qualities were, with some qualification, interrelated as that theory predicted. 2) Each of the political qualities valued by the theory was associated with greater ability to support democracy (measured by integration with state and community, and acceptance of democratic values). The qualities derogated by traditional theory, but thought necessary by social system theory, were found to be associated with lesser ability to support the democratic system.

Analysis of the relationship between aspects of the social structure and the political qualities showed education, community integration, status and urbanization to be associated with the qualities valued by traditional theory.

We conclude that: 1) In terms of both theories the lower working class is least supportive of the democratic system. 2) Though the upper middle class is deficient in terms of the social system theory it exceeds the other classes in those qualities valued by the traditional theory. 3) The fact that the social system theory admits that a distribution of the four dimensions is necessary means that, at the same time, it is accepting the associated characteristics (less democratic behavior and perspectives). 4) Therefore, some means must be found to reconcile the traditional theory, with its accurate assessment of the relationship between an individual's political qualities and democratic behavior, and the social system theory, with its recognition of the realities of politics in a complex industrial society. 5) American society, as represented in Detroit, seems to be moving in the direction of greater attainment of the behavior patterns valued by traditional theorists. Thus the reconciliation of the two theories must be made if social policy is to be wisely formulated.

Microfilm $3.45; Xerox $12.15. 268 pages.

THE INFLUENCE OF ECOLOGICAL AND DEMOGRAPHIC FACTORS ON COMMUNITY OPPOSITION TO SCHOOL DISTRICT REORGANIZATION

(L. C. Card No. Mic 60-5670)

Kenneth Carl William Kammeyer, Ph.D.
State University of Iowa, 1960

Co-Chairmen: Professor Albert J. Reiss, Jr.
Professor J. Richard Wilmeth

This was a comparative community study designed to ascertain the effects of community attributes of an ecological or demographic nature on a community decision.

One-hundred and eleven Iowa school districts which had voted on school district reorganization proposals between 1956 and 1959 constituted the cases analyzed. The reorganization proposal that each of the districts voted on had the effect of closing the high school in the districts and sending the high school students to school in another community. (To facilitate communication the district which was to close its high school will hereafter be called the "losing district." The district which will receive the students from the discontinued high school will be called the "gaining district.")

The dependent variable in this study was the opposition to school district reorganization in the losing district. The measure of this variable was the percent of the vote in the losing district that was negative (opposed to the reorganization proposal).

The independent variables were of two types. One type was called "situational variables" and the other was called "attributes of the losing district." A situational variable is some measurable characteristic which is present in every reorganization proposal. (E.G., the relationship between the sizes of the high schools in the losing and gaining districts.) Attributes of the losing district included the nationality homogeneity or heterogeneity of the losing school district, and community type of the losing district determined on the basis of the economic and professional services offered in the population center of the district.

Produce moment correlation and analysis of covariance were the statistical methods used to measure the degree of association between the independent variables and the dependent variable, the percent of the vote that was negative in the losing district.

The correlation coefficients between the situational variables and the dependent variable tended to be generally low. However, three independent situational variables were found to have some association with the percent negative vote in the losing districts. These three were:

1. High school ratio. The high school ratio was computed by dividing the number of students in the gaining district's high school by the number of students in the losing district's high school. The larger the high school ratio value the greater is the disparity between the sizes of the two schools. The high school ratio for 111 cases had a positive correlation of .23 with the percent of the vote that was negative in the losing district.

2. Size of the losing district population center. The size of the population center in the losing district had a -.29 correlation with the percent negative vote in the losing district. Thus, the smaller the town in the losing district the greater the opposition to school district reorganization proposals tended to be.

3. Assessed valuation ratio. The assessed valuation ratio was computed by dividing the assessed valuation per resident child in the losing district by the assessed valuation per resident child in the gaining district. The resultant ratio represented a relative measure of the wealth of the two districts. The larger the ratio is the more the wealth of the losing district exceeds that of the gaining district. A positive correlation of .23 was found between the assessed valuation ratio and the percent negative vote in the losing district. The more wealthy the losing district is in relation to the gaining district, the more there tends to be opposition to school district reorganization proposals.

The multiple correlation between high school ratio, population center (losing district) and assessed valuation ratio and the dependent variable, percent negative vote in the losing district was .44.

By using the method of analysis of covariance it was found that school districts which were homogeneous in their nationality composition did not differ in the amount they opposed reorganization proposals from districts that were heterogeneous in their nationality composition.

There was also no difference in the opposition to school district reorganization among the districts that had been grouped according to community type. Communities which offered most of the services needed by community members did not oppose reorganization proposals more than communities which had only a minimal number of such services, as it had been expected they would.

Microfilm $2.75; Xerox $7.80. 168 pages.

THE SOCIAL FUNCTIONS OF HUMOR

(L. C. Card No. Mic 61-1463)

Henry Grady Pitchford, Ph.D.
Emory University, 1960

Director: Helmut Schoeck

The dissertation is a theoretical analysis of the social functions of humor. It postulates that humor, a universal phenomenon, has consequences for the adaptation or adjustment of a given social system. No theory of humor exists which can explain what humorous communications do for actors in their interhuman relationships.

Chapter I introduces the dissertation and states the problem.

Chapter II is a review of the literature on humor. The principal theories of humor are analyzed under the following headings: 1. Superiority theories; 2. Release-from-restraint theories; and 3. Incongruity theories. Studies of humor made by psychologists and sociologists are summarized. The former have investigated the relationship of humor to personality. The latter have investigated humor as a social control measure and as a technique of conflict.

Chapter III describes the methodology of sociological studies of humor. The principal defect of most of these studies has been the lack of a theoretical model for analyzing humorous communications. Moreover, jokes have been used as data with no consideration of the social situation in which the jokes were communited. The function of humor

must be located in the social structure in which it occurs.

Humor is an interactive process which involves particularly close communication, for successful humor requires a consensus on the definition of the situation. It may be used to initiate communication in situations where communication is difficult to establish because of the lack of a consensually validated basis. It may sustain communication under dangers of break-off.

Chapter IV analyzes the concepts of humor research. Wit and humor are distinguished from ridicule. Both wit and humor are utilized by actors who wish to communicate with other actors. Ridicule, conversely, attempts to destroy communication with other actors and to degrade their status. Humor and wit are objective definitions of incongruous situations. Incongruous social, cultural, and physical items are those which vary in intensity, quality, or quantity from the state the actor has come to expect as a consequence of cultural standards. If an objective definition of the situation is not made, the response to incongruity may be fear or indignation.

Chapter V analyzes humor as a mode of interaction for achieving consensus. Humorous communications aid actors to maintain a body of reciprocal behavioral expectations, by: 1. permitting the expression of hostility, envy, and other potentially disruptive sentiments; 2. providing an arena for the expression of doubt and disrespect; and 3. providing a standardized mode of behaving in situations which contain structurally built-in potentialities for conflict.

Chapter VI describes humor as a social control measure. Control is defined as any method of implementing conformity to norms by the application of positive or negative sanctions. Humorous communications remind an actor that his behavior is incongruous. They also reaffirm norms which have been violated.

Chapter VII differentiates between humor and ridicule, the former being utilized in competitive relationships, and the latter in conflictive interactions. Competitive situations presuppose a higher degree of communication than do conflictive situations. The latter are characterized by a suspension of communication between opponents. Thus, ridicule may be used to destroy communication. Humor is utilized in situations in which it is desirable or necessary to continue to communicate with an opponent. The humorous communication enables an actor to point out humorous incongruities in the ideology, behavior, or policy of his opponent, and to make a rhetorical appeal to an audience to accept his definition of the situation. The opponent, in turn, can retaliate with humor and wit. Ridicule, however, is used to destroy or banish an opponent or a social or cultural item. It reduces power by mockery, raillery, derision, and scorn.

The concluding chapter summarizes the findings of the dissertation.

Microfilm $2.75; Xerox $9.70. 212 pages.

A THEORETICAL ANALYSIS OF "STATUS" AND STATUS-ORIENTED BEHAVIOR.

(L. C. Card No. Mic 61-1464)

Beth Elaine Ensminger Vanfossen, Ph.D.
Emory University, 1960

Director: Helmut Schoeck

The three major purposes of this dissertation were: (1) the analysis of the sociological uses of the concept "status"; (2) an examination of the theoretical and empirical findings concerned with status phenomena; and (3) the formation and presentation of a heuristic sociological concept of status.

When a concept is used with great frequency over a long period of time, the disadvantages of definitional vagueness outweigh the advantages. Therefore, it is important that a concept such as "status" should be made explicit. Many writers have complained that the concept "status" has too many meanings attached to it. This was found to be true. Several meanings frequently implied in the use of the term "status" are: status as position; status as sum total of positions; status as a level in a hierarchy; status as indexed by objective characteristics; status as an objective entity apart from the individual who occupies it; status as a subjective entity dependent on the individual who occupies it; status as prestige; status as a collection of rights and duties; status as the static aspect of "role." The status models of five theorists were discussed: Ralph Linton, Kingsley Davis, Richard LaPiere, E. T. Hiller, and Chester I. Barnard.

The lack of definitional consensus does not necessarily mean the concept is losing its efficacy to the field. It seems probable, instead, that there is, in empirical reality, a phenomenon which is quite profitably described, discussed, and noted through the use of this concept.

People in every society are characterized by heterogeneous attributes. As a result of this differentiation, individuals classify each other. However, the degree, extent, and basis of classification varies from situation to situation and from individual to individual. "Status" was defined as a mental category, inclusive of some expectations of behavior, in which the individual is placed by relevant others, who have a conception of his behavior in specific instances. The definition of status as social classification clears up several conceptual difficulties: it allows both broad and specific statuses to be considered; and it allows for a separation in meaning between "status" and "prestige."

The degree to which the behaviors of an individual correspond to his status or statuses depends upon the situation in which the individual is operating, the strength of the expectations regarding his behavior, and the importance or pervasiveness of the status which is being activated.

When a situation of "social certitude" exists, that is, when individuals know how they relate to each other, interaction can proceed relatively smoothly. When there is "social uncertainty," individuals are uneasy and do not know what to expect. Research studies have found that often persons characterized by low status crystallization will react differently from those characterized by high status crystallization. However, this does not always happen, because individuals are flexible and may become

used to their inconsistent statuses. Statuses frequently become endowed with evaluations, prestige, or differential respect. In any larger society some degree of status differentiation is inevitable. Social scientists and intellectuals tend to overemphasize the degree of status-strain and striving among lower and middle class individuals. The theme that individuals are perpetually driven by feelings of insecurity, anxiety, anomie, and rootlessness, was perpetuated by the anti-urban sociologists of the early twentieth century, and is carried on presently through recent formulations such as the "organization man," and the "status seekers."

"Status" may be "generic" or "specific." An individual has many statuses; but these do not combine to form his total status; rather, they are activated at different times. A definition of status must of necessity be conditional and qualifying, if it is to reflect the realities of social interaction. Microfilm $3.15; Xerox $11.05. 242 pages.

A THEORETICAL MODEL FOR THE ANALYSIS OF SOCIAL INTERACTION SITUATIONS

(L. C. Card No. Mic 61-1465)

Marion Gilbert Vanfossen, Ph.D.
Emory University, 1960

Director: Helmut Schoeck

The purpose of this study was the development and explanation of a theoretical model, and the demonstration of its utility for the analysis of social interaction situations. The area of sociological theory was discussed and a definition of theory was offered.

The method and procedure of this study follows the principles of (1) location, (2) formulation, statement, and explanation; (3) application and documentation in this general order. It was considered the most legitimate method on the assumption that: (1) a theory should be located with reference to the limits imposed by its basic assumptions and methodological techniques as concerns possible theoretical orientations and differing frames of reference; (2) its particular assumptions and pivotal concepts should be adequately stated and explained; (3) discussion, application, and documentation attest to its usefulness for analysis.

The theory was located and classified as systematic analytical theory. It assumes the action or interaction frame of reference by concentrating on the results and effects of relations among actors (individuals or groups), and by embracing the idea of purposeful goal-oriented behavior. It employs the assumptions of system analysis in those cases in which situations or collectives are patterned, organized, structured, enduring, and relatively independent. The basic concepts which were developed by the theory are "commitment" and "lines of action." Lines of action are action sequences which are assumed by an actor to be possible and suitable for achieving his objectives. A commitment is any restriction in choice of (1) all of the possible lines of action which may be assumed to exist within a situation for the acquisition of an objective, and (2) all the possible objectives which are offered by the situation.

A condition of most-commitment is one in which an actor has no open lines of action. Commitment may be internal to the individual (i.e., values, attitudes, etc.) or external (i.e., demands made upon him but to which he entertains no value). Romantic love and martyrdom were analyzed as situations of internal most-commitment; apprenticeship was considered as an example of external most-commitment.

External most-commitment is a condition of authority systems. A pure authority system is a situation in which commitments and expectations balance. A situation of power potential is one in which commitments and expectations become imbalanced and in which predictability is reduced. Power potential is thus the breakdown condition of an authority system. Power is a sustained imbalance of commitments and expectations in the favor of a referent actor. Authority is legitimate control. Power is illegitimate control in the sense that it is not yet (if ever) legitimized. The "blending" of internal and external commitment is one method of social control fostered by an authority system. It is the basis of both conformity and opposition to the system.

The principle of least-commitment is directed toward objectives of power or freedom, and is "played" within an authority system. It is the most adequate adjustment between the behaviors necessary to gain the rewards of an authority system and the objectives of "self" and freedom. As a strategy of action it includes the techniques of uninvolvement, anti-classification, and calculated commitment. Calculated commitment has many and diverse forms of application depending on the relative importance of goals, the interdependence of subjective and objective evaluations, and the realization of the fallacy of over-commitment.

The principle of least-commitment does not endorse social (societal) relativism, nor is it antithetical to society or social control. It is limited in its application as a rational plan of action to those situations wherein an actor wishes to maintain freedom and "self" in the face of an over-demanding authority system. It does not question the value of discriminative most-commitment.

Microfilm $3.50; Xerox $12.40. 271 pages.

THE IMPLICATIONS OF ZONING DATA FOR ECOLOGICAL THEORY

(L. C. Card No. Mic 61-1379)

Sidney McLarty Willhelm, Ph.D.
The University of Texas, 1961

Supervisor: Professor Gideon Sjoberg

An analysis of the empirical data collected by this writer in Austin, Texas, during the period January, 1956, through June, 1960, from official files and at public sessions of decision-making bodies which process zoning applications--the City Planning Commission and the City Council--indicates certain shortcomings of current theory in the field of human ecology. The materialistic ecological orientation, one school of thought, denies the relevance of social values in ecological investigation and instead seeks explanations in 1) biotic, subsocial forces or 2) "physical," "external" variables such as population, environment,

technology, and social organization. Voluntarism, the second ecological school, argues for ecological interpretations within the framework of social organization--by investigating social values, structures, and functions, processes, and/or power.

Certain limitations inherent in these two ecological schools prompted the writer to reject entirely the materialistic frameworks and to modify the existing voluntaristic conceptualizations for the analysis of ecological phenomena. The writer developed an alternative ecological framework--"the cultural approach"--and tested his hypotheses in terms of the zoning data he collected. The cultural approach, a modification of existing voluntaristic orientations, appears to offer a more systematic perspective for defining and interpreting ecological developments.

Briefly, the cultural approach holds that man locates over space in terms of the social activities he performs. The cultural ecologist accounts for ecological phenomena in 1) the social goals that orient man to space; 2) the selection, from alternatives, of a means for attaining these objectives; 3) the social conditions that influence the selection of a means; and 4) social values as these are related to the goal, means, social conditions, and cognitive data.

The first two of the four hypotheses of this study concern the adequacy of the cultural orientation to ecology, as developed in this dissertation, in light of the zoning data; the third hypothesis contends that the theoretical writings of those ecologists espousing a materialistic orientation fall within the cultural framework; and the fourth hypothesis argues that competition in the ecological realm is a social process rather than a sub-social force as the materialistic ecologists maintain.

Each hypothesis was sustained by the empirical data; the writer uncovered none negating the four hypotheses. Although other empirical ecological studies should be undertaken to test further the hypotheses set forth in this dissertation, this writer believes that the cultural approach is the most useful for explaining ecological phenomena.

Microfilm $4.10; Xerox $14.40. 319 pages.

SOCIOLOGY, FAMILY

FAMILY STRUCTURE IN JAMAICA: THE SOCIAL CONTEXT OF REPRODUCTION.

(L. C. Card No. Mic 61-1400)

Judith Blake Davis, Ph.D.
Columbia University, 1961

Based on data obtained (by trained Jamaican interviewers) from a lower-income sample in Jamaica (99 women and 53 men), this pilot study utilizes modern survey techniques to examine features of Jamaican family structure that are relevant to reproduction. A scheme is utilized delineating the 11 variables through which socio-cultural factors can affect fertility--variables such as the age at entry into sexual unions and the degree of stability of such unions. Such a systematic treatment of factors affecting fertility is particularly rewarding in the case of Jamaica because of the unusually high rate of illegitimacy on the island. Illegitimate births typically account for about two-thirds of all live children born. The study shows that such illegitimacy rates reflect not simply non-marriage but also extreme instability of sexual association. This instability in turn gives rise to sizeable periods of celibacy for women throughout the reproductive period, thereby having an independent effect in lowering fertility over what it would be if sexual associations were stable. Information is also obtained on attitudes toward limiting family size, toward birth control in general, and toward specific methods of contraception, as well as data on the actual practice of family limitation.

Much systematic attitudinal material was also gathered which sheds light on Jamaican family behavior. In particular, analyses are presented of motivational and social factors leading to extremely youthful non-legal unions among Jamaican girls; the features of Jamaican life that make women shun a common-law association for as long as they can; and the attitudinal and socio-economic factors that deter marriage until late in life. Many of the findings of this study do not bear out statements by other researchers about the Jamaican family situation--statements based mainly on informal research techniques such as acquiring information about "the culture" from a few "knowledgeable informants." For example, analysis of the attitudes of all of the members of a defined sample shows that these people do not spurn marriage as a way of life and that such allegedly negative feelings do not therefore account for large-scale non-marriage and illegitimacy.

The empirical results in Jamaica support the normative universal already noted by Malinowski, namely, that a socially legitimized context for reproduction is typically preferred in all societies. However, since in actual fact illegitimacy is so prevalent in the West Indies, the author tries to show how weak social controls (inherited from slavery) are self-perpetuating in spite of desires by individual Jamaicans for a more controlled and organized way of life. Microfilm $6.30; Xerox $22.30. 493 pages.

PERSONALITY CHARACTERISTICS—IDEAL AND PERCEIVED IN RELATION TO MATE SELECTION

(L. C. Card No. Mic 61-1701)

Elsie Viola King, Ph.D.
University of Southern California, 1961

Chairman: Professor Peterson

This is a sociological study of the concept of romantic idealization. By this concept is meant the tendency of persons in love to become blind to the faults of their future spouses and to overvalue their virtues. Many writers have employed this concept and felt that it was a universal phenomenon occurring among those who are romantically involved. This study attempts to measure the incidence of romantic idealization as it appears among applicants for marriage licenses. The second objective is to determine if those who idealize differ from those who do not perceive the partner in unrealistic terms. The third objective is to

determine the incidence of romantic idealization in conceptions of the "ideal mate" and to study the effect of possible correlates with this phenomenon.

Two hundred and fifteen couples applying for marriage licenses were studied to determine the incidence of romantic idealization as well as to seek possible correlates of such among the following variables: sex membership, ethnicity, socioeconomic status, age, marital status, and length of engagement. The methodology employed consisted of asked the partners in the prospective marriage to fill out the Interpersonal Checklist in such a way as to describe the partner and also to describe the "ideal mate." A short questionnaire gathered the data for the other variables under consideration. Appropriate statistical techniques were employed to test the significance of the findings.

Findings. (1) While not a universal phenomenon, the incidence of romantic idealization of the prospective mate is, indeed, higher than expected by chance. (2) Women seem more prone toward romantic idealization than men. (3) Ethnic membership, socioeconomic status, marital status, and length of engagement seem to be unrelated to the incidence of unrealistic perceptions of the prospective mate. (4) Age does appear to be related to the incidence of idealization. The incidence is significantly higher among those age forty and above when compared with the teenagers, those in their early twenties, and those in their thirties. (5) Unrealistic conceptions of the "ideal mate" occur more frequently than would be expected by chance among this sample of persons. (6) Again, more women than men tend to romanticize the "ideal mate." (7) Ethnic membership, socioeconomic status, age, marital status, and length of engagement appear to be unrelated to the incidence of unrealistic conceptions of the "ideal mate."

Additional analysis of the data showed that none of the subgroups differed on the intensity dimension of romantic idealization. Thus, the degree of idealization is not differentially correlated with any of the variables under study.

This study is the first in a series of longitudinal studies of the development of relationships in marriage. Subsequent studies will provide data for the assessment of the relationships between the above findings and subsequent marital adjustment of this sample.

Microfilm $2.75; Xerox $8.20 177 pages.

SOCIOLOGY, PUBLIC WELFARE

CASEWORKERS' USE OF GROUPS IN DIRECT SERVICE

(L. C. Card No. Mic 61-1705)

Guido Pinamonti, D.S.W.
University of Southern California, 1961

Chairman: Professor Hamovitch

Recent developments in the social work profession have spurred a re-examination of the generic-specific concept in social work education and practice. Although caseworkers' increased use of group methods represents a noteworthy trend in casework practice, there has been relatively little systematic study of this development. This study examined the extent of social caseworkers' work with direct service groups in Los Angeles County and describes their educational preparation for this function, their actual work experience with groups, and their understanding of group process. In addition, the study (1) solicited the opinions of the caseworkers and executives regarding the appropriateness of this function for social caseworkers and (2) considered the variety of factors which influenced caseworkers and executives to embark on a program of group services.

The inquiry was conducted during the calendar year 1960. Data were secured through electric tape-recorded interviews with 38 professionally educated social caseworkers and 24 social service executives. The social caseworker interviewees represent a 30 per cent random sample stratified on the basis of employment in four categories of public and private agencies: medical and psychiatric hospital, medical and psychiatric nonhospital, family and children's residential, and family and children's nonresidential. The executives were interviewed on the basis of their casework staff being included in the sample. Two distinct interview schedules were used for each group of interviewees.

Findings. The practice of work with groups by social caseworkers is not as extensive as anticipated. Only 128 professionally educated caseworkers in Los Angeles County worked with groups. However, eight out of every ten caseworkers in the sample thought that their work with groups was definitely a social work function. Three fourths of the caseworkers indicated they received social work supervision relative to this function, but over half of the caseworkers had had neither professional educational nor in-service training for work with groups. A majority of the caseworkers relied heavily on personality theory in working with groups and gave evidence of having very limited understanding of social science contributions to group process. A disturbing fact was that most of the caseworkers thought the group methods courses in the master's program had not prepared them for their work with groups. Moreover, three fifths of the caseworker interviewees had not attended any sort of post-master's course related to work with groups. Also of concern was the fact that three fourths of the executives had not provided consultation services for staff working with groups. Interestingly, a majority of the executives interviewed thought that social caseworkers would be called upon increasingly to lead groups.

Important tasks for social work education are (1) to foster in students a respect for the contributions of a second method, (2) to provide students with some understanding of the principles and processes of the second method, and (3) to study field work placements to determine whether some experience in a second method is feasible for students.

On the other hand, social agencies would do well (1) to examine and articulate what jobs they expect social work graduates to do, (2) to analyze the knowledge and skills required for various functions within practice, and (3) to re-examine why work with groups is being done by social caseworkers.

Although the distinction between casework and group work as methods appears to have become less important as more and more social workers have had to work with individuals, groups, and communities, the study data give no evidence that a generic social work practice exists today.

Microfilm $4.75; Xerox $16.90. 372 pages.

THE PLAYS OF EUGENE O'NEILL AS PRESENTED BY THE THEATRE GUILD

(L. C. Card No. Mic 61-1592)

Mary Hedwig Arbenz, Ph.D.
University of Illinois, 1961

The purpose of this study was: to discover the interrelationships between Eugene O'Neill's plays and the productions given them by the Theatre Guild in New York; to determine how and in what degree the textual changes made for the acting version and the production affected the immediate fate of the individual play, subsequent plays, O'Neill as a creative artist, and the Theatre Guild as a producing organization.

The principal sources were: galley proofs of the plays, bound and unbound prompt scripts, typescripts, ground plans, photographs of settings and costumes, theatre programs, property, costume, and lighting plots, and like material in the Eugene O'Neill and Theatre Guild Collections, Yale University Library. Newspapers, periodicals, and books provided critical comment on plays and necessary background material.

Pertinent material in the life of O'Neill and the history of the Guild prior to their association sets the stage for the examination of each play in order of production: Marco Millions, Strange Interlude, Dynamo, Mourning Becomes Electra, Ah, Wilderness!, Days Without End, and The Iceman Cometh. The study discusses revisions made for the acting version, assigns or estimates cause, and describes effects on the text. It examines production--settings, costumes, direction, acting--and judges the influence of production on each play's reception.

The majority of O'Neill plays produced by the Guild were well constructed scripts whose textual alterations for the acting version decreased repetition, strengthened motivation, integrated explanatory passages, or quickened action. For Marco Millions, Dynamo and Days Without End, textual alterations were either harmful or not beneficial. Occasionally, casting, acting, settings, or direction failed a script but more often enhanced its virtues.

The production of O'Neill's plays brought publicity, financial gain, and renown to the Guild. However, during its most precarious years, when lack of good scripts and failure of its plays almost caused its dissolution, O'Neill released no new scripts.

Although the Guild caused changes in particular scripts, it had little or no long-range influence on O'Neill. Only the pragmatic test of audience reception had lasting effect, primarily on form not content. Success of long plays--Strange Interlude, Mourning Becomes Electra--and failure of usual length plays encouraged him to continue using outsize forms. The semi-failure of Marco Millions turned him from the many-scened poetic play. Success of Strange Interlude with its soliloquies and asides induced him to write Dynamo in a similar style, but that play's failure caused him to discard these devices. After the stillborn Days Without End, he no longer used masks.

A production's influence on other aspects of his writing is not so clear. Probably the failure of Days Without End, added to that of Dynamo, caused O'Neill to choose eras other than modern for subsequent plays, may have turned him again to characters of lower social and economic levels, and confirmed his tendency toward realistic settings. Although productions seem not to have made him technically more sure, they probably helped him create characters independent of thesis.

Without association with the Guild, Eugene O'Neill's art probably would have developed differently; without O'Neill, the Theatre Guild would have continued to function but been the poorer. Together, they formed a mutually beneficial association which gave the public many interesting and noteworthy productions.

Microfilm $6.80; Xerox $24.10. 533 pages.

CHICAGO THEATRE AS REFLECTED IN THE NEWSPAPERS 1900 THROUGH 1904

(L. C. Card No. Mic 61-1604)

Wilma June Dryden, Ph.D.
University of Illinois, 1961

This study focuses on the theatre of the city of Chicago, as reflected in newspaper criticism and reporting, for the five years from 1900 through 1904. It presents, therefore, not a survey but a composite of the constituents of Chicago theatre in their relation to the currents of the city and the times and to each other.

The two most significant trends of Chicago theatre in these years could be distinguished in the cities and nations of an increasingly industrialized world--those toward material expansion and toward "enlightened progress." These trends serve to divide the material of this study; the physical aspects fall naturally into that toward material expansion, the intellectual and aesthetic into that toward "enlightened progress."

Chapter I, entitled "Chicago, Its Newspapers, and Their Drama Critics," contains background material. It gives an account of the development of the city from the time of the Great Fire to the end of the century and a brief description of each newspaper and the critic or critics who served it in the five year span.

In Chapter II, "Material Expansion," a description of the productions of representative theatres is incorporated into the account of the increase in production which occurred in both the popular and high-class theatres as old theatre buildings were reactivated and new ones built in downtown and outlying districts. The multiplication of the stock companies, the ventures to originate productions in Chicago, and the building of two new theatres by Syndicate producers are considered as well as the temporary curb to expansion provided by the Iroquois Theatre fire.

Chapter III, "Enlightened Progress: The Mode of the

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Real," examines the range of repertory presented, the vogues in costume, scenery, and lighting, and the practices in directing and acting as they relate to realism, the concept of the progressive in the value judgments of the majority of the Chicago critics.

The conclusions point out that the physical growth of Chicago theatre was common to theatre throughout the country, but the reappearance of the stock company in Chicago and the attempt to make the city a theatrical producing center were vigorous movements not paralleled in the nation.

Intellectually and aesthetically the Chicago theatre was very much like that of the rest of the Western world. In its acceptance of the "new" realistic drama it was not behind New York or the great cities of Europe. Some of its critics were in the vanguard seeking to promote the newer symbolist drama and staging. In these years Chicago theatre seemed to be rising in national importance.

Microfilm $2.75; Xerox $8.20. 176 pages.

AN ACOUSTICAL ANALYSIS OF QUALITY VARIATIONS IN SUNG VOWELS

(L. C. Card No. Mic 60-6874)

George Henry Gunn, Jr., Ph.D.
University of Michigan, 1960

This study is concerned with six voice quality variations in sung vowels termed bright, dark, spread, nasal, head and throaty qualities. The principle problem was to determine the relationship between perception of each of these qualities and variance in the following vowel characteristics:

(1) fundamental frequency;

(2) frequency position, relative intensity and band width of formants one, two and three;

(3) relative intensity at 250, 500, 1000, 2000, 2400 and 2800 cps.

An additional problem was to determine whether perception of the six voice qualities differs significantly for tones classed as: (1) front, mid and back vowels; (2) tense and lax vowels.

Two hundred sixteen sustained vowel sounds were produced by four male singers. Two singers attempted to emphasize selectively each of the six voice qualities while producing (i), (ɪ), (e), (ɛ), (a), (ɔ), (o), (ʊ) and (u) on fundamental pitches of approximately 220 cps. The third and fourth singers attempted to produce each quality variation on (e), (a) and (o) on fundamental pitches ranging from 110 to 265 cps.

A two second signal from each sound was recorded five times in close succession on a set of master tapes. Nine experienced listeners assigned phonetic classifications and voice quality ratings to the recorded sounds. A four point scale was used in rating spread, nasal, head and throaty qualities. It was assumed the terms "extremely bright" and "extremely dark" represent polar points on a continuum: accordingly, a single seven point scale was used in rating bright-dark quality. The mean voice quality ratings and the phonetic classification agreed upon by a majority of the listeners were assigned each vowel.

Narrow band spectrograms and five frequency-amplitude sections were made of each sound. When a frequency vibrato could be distinguished, the sections were taken at 0°, 90° and 270° phase in successive waves. The mean fundamental frequency, formant characteristics and intensities in the selected regions were computed for each vowel. The relationship between the voice quality ratings and phonetic quality classifications was tested by means of t-tests. The relationship between the voice quality ratings and the selected acoustic measures was tested by means of Pearson product-moment coefficients.

From an analysis of the findings, the following general conclusions appear warranted:

(1) The differences in voice quality investigated in this study appear to be related with peculiar shifts in frequency position and energy distribution among the vowel formants.

(2) There is a positive relationship between listener ratings of bright-dark quality and:

a. the frequency position of formants one and two,

b. the relative intensity of formants two and three,

c. the relative intensity of harmonics in the region of 2800 cps.

(3) There is a negative relationship between listener ratings of bright-dark quality and:

a. the relative intensity of formant one,

b. the relative intensity of harmonics in the region of 500 cps.

(4) The evaluation of spectral slopes may serve as a convenient measure of the acoustical correlates of bright-dark quality.

(5) The perception of spread quality may be related with an inordinate shift in formant two frequency position in the direction of the high frequency region, as compared with the shift in the frequency position of formant one.

(6) There is a positive relationship between listener ratings of head quality and the band width of formants two and three.

(7) The observations reported previously that nasality is associated with a reduction in intensity of formant one, combined with an increase in the formant bandwidth, are generally supported by the results of this study.

(8) There is a direct relationship between throaty quality ratings and shifts in the frequency position of formant three in the direction of the low frequencies.

Microfilm $2.75; Xerox $6.60. 140 pages.

PERCEPTIONS OF TYPICAL AND IDEAL SPEECH THERAPY AND ABILITY TO EVALUATE THERAPY

(L. C. Card No. Mic 61-1880)

Edwin W. Martin, Jr., Ph.D.
University of Pittsburgh, 1961

The purpose of the study was to investigate possible relationships between speech clinicians' perceptions of themselves as similar to an "ideal" and their ability to evaluate their therapeutic behavior.

Eleven speech clinicians, each acting as therapist for an adult client diagnosed as a "stutterer," served as subjects. Each clinician was required to rate items on three forms with respect to the degree he felt the items were characteristic of his "typical" therapy, "ideal" therapy, and a tape-recorded sample of his therapeutic behavior. Ratings were made on an eight-point scale ranging from "very characteristic" to "very uncharacteristic."

One form was used for the "Typical" and "Ideal" ratings, and two forms, a Description form and an Evaluation form were used for rating the tape-recordings. Each form included six dimensions, Communication, Emotional Distance, Information about Speech, Status, Directiveness, and Interpretation.

A panel of experieced judges rated each therapy tape. Correlation coefficients were computed expressing the relationship between each subject's "Typical" and "Ideal" ratings, and between each subject's rating of his tape-recorded therapy and the judges' ratings of the tape-recorded therapy.

Analysis of the data indicated that the judges were able to rate with acceptable reliability the therapy tapes presented them.

Typical and Ideal ratings were significantly correlated for each subject. Typical-Ideal correlation was lowest for the "Directiveness" and "Interpretation" dimensions. This tendency for low correlation was also observed for these dimensions in the analysis of Judge-Clinician agreement. Tentative explanations for these observations were presented suggesting that theoretical variation between speech therapy and psychotherapy might be related to the low agreements for these dimensions.

In general, the speech clinicians studied were able to agree relatively well with experienced judges in evaluating their therapy.

Three measures employed for analyzing the relationship between Typical-Ideal agreement and Judge-Clinician agreement showed positive correlations between varying aspects of these variable. Tentative explanations for this relationship were offered. Explanations were based on hypotheses suggesting the relationship noted might be explained in terms of clinician "adjustment," general evaluative experience, or perceptual "conflict."

Microfilm $2.75; Xerox $6.00. 124 pages.

THE HISTORY AND DEVELOPMENT OF SIMULTANEOUS SCENERY IN THE WEST FROM THE MIDDLE AGES TO MODERN UNITED STATES

(L. C. Card No. Mic 61-1547)

Alice Lida Peet, Ph.D.
The University of Wisconsin, 1961

Supervisor: Assistant Professor F. A. Buerki

Simultaneous scenery is defined in this work as a setting which is characterized by its recognizable, representational quality and the use of multiple locales which remain essentially in view of the audience during the entire performance.

Simultaneous scenery was developed by the clergy of the medieval Church. When liturgical drama became too demanding in space and too secular in content to remain in the church, it moved, scenic style intact, to the market square. The settings were simple, representational scenic units called mansions which were placed in an unlocalized acting area called the platea. Often three separate levels were used to represent heaven, earth and hell. Traps, scaffolds and other machinery were used to create ascents and descents from level to level. As the centuries passed, the number of mansions increased and the machinery became more complex. The highest development of simultaneous scenery in the Middle Ages was achieved in France.

The theatrical trends of the Renaissance put an end to medieval staging everywhere in Europe except at the Hôtel de Bourgogne in Paris where Alexandre Hardy found the built in medieval devices enhanced the action of his plays. The only major difference in the settings of Hardy's plays was the change of the mansion to an elaborate construction employing painted realism.

After Hardy, simultaneous scenery was gradually replaced by the simple sets of the neo-classic drama, which were in turn supplanted by the more complicated Italian stagecraft which remained dominant in Europe for almost two centuries. It was not until the late nineteenth century that Adolphe Appia and Gordon Craig brought new ideas to scenic art. In the United States, the movement was welcomed by men, like Robert Edmond Jones, who believed that scenery should be a silent character in the play which magnified and intensified the mood. Applying this theory to the problems of Eugene O'Neill's Desire Under the Elms in 1924, Jones designed the first major American simultaneous setting. Since that time designers have frequently used this method of staging to achieve the easy flow of action necessary for plays written in the mobile style currently popular in motion pictures and television dramas.

Methods of staging are usually developed and maintained because they are particularly suited to the needs of the dramatic literature they serve. It was this kind of peculiar fitness which led to the development of simultaneous scenery in the medieval church, to its continued use and growth in the market place, to its survival under Alexandre Hardy and to its revival in twentieth century United States.

Microfilm $5.05; Xerox $17.80. 393 pages.

AN ANALYSIS OF ARTICULATORY DEVIATIONS IN CHILDREN BETWEEN THREE AND SEVEN YEARS OF AGE AND THEIR RELATION TO MOTOR AND AUDITORY TEST PERFORMANCES

(L. C. Card No. Mic 61-1823)

T. David Prins, Ph.D.
University of Michigan, 1961

Disorders of articulation for which no demonstrable organic basis can be established are labeled functional. Factors which have been considered as possible bases for functional articulatory disturbances include so-called normal deviations in physical and psychophysical characteristics and abilities, environmental circumstances, personality, and intelligence.

Of particular interest to researchers in the past has been the possibility of subclinical deviations in motor and auditory abilities in individuals with functional disorders of articulation. The design in most earlier studies has been to compare the performance of a normal-speaking population with that of an articulatory defective on a series of motor and auditory skill tests. This approach has not been productive relative to showing motor or auditory deviations in functional articulatory defective subjects. The results of these studies are conflicting. No consistent differences in motor and auditory skills between populations of articulatory defective and normal-speaking individuals have been shown.

A few researchers have evaluated motor and auditory skills in subjects who differed in their number or types of articulatory deviations. The data from these studies suggest that the population with functional defects of articulation may be composed of subgroups or syndromes which are distinguished by differences in both articulatory performance and motor and auditory abilities. With this in mind, the purpose of the present study was to investigate the heterogeneity of a population of articulatory defective children as evidenced by differences in the relations among specific types of articulatory deviations and, in addition, other selected variables, particularly motor and auditory skills.

The experimental population was composed of 92 articulatory defective children between three and seven years of age. Seventy-one subjects with adequate articulation constituted the controls. Experimental and control populations were matched relative to factors of age, sex, intelligence, socioeconomic status and the presence of siblings in the home.

A detailed analysis of the articulatory deviations of the experimental subjects was made using a system devised specifically for this study. In addition, a battery of motor and auditory skill tests was administered to both experimental and control populations. Motor skill tests included measurement of static and dynamic equilibration and non-equilibratory coordination. The measured auditory abilities were memory span and speech sound discrimination.

Results of statistical analyses of the data indicated differences among the correlations of selected articulation scores with other articulatory and non-articulatory variables from the test battery. Also, subgroups of experimental subjects which were defined on the basis of selected articulation scores were found to differ from each other and from the experimental population in certain motor, auditory, and other non-articulatory variables.

From these results the following general conclusion seems warranted: the population of children with functional defects of articulation appears to be heterogeneous. Three independent subgroups within this population are indicated by varying relations among specific articulatory deviations and selected motor and auditory skills, socioeconomic status and intelligence. Each subgroup was tentatively identified by a particular articulatory error: group one, the interdentalization of the /s/ and /z/ phonemes; group two, omission-type deviations; group three, sound substitutions in which only standard English phonemes are employed and in which a single sound feature of the intended phoneme is altered.

Microfilm $2.75; Xerox $6.00. 124 pages.

A HISTORY OF THE LUTHERAN TELEVISION PRODUCTION, THIS IS THE LIFE FROM 1952-1958.

(L. C. Card No. Mic 61-1779)

Frederick Brooks Sanders, Ph.D.
University of Michigan, 1961

The purpose of this study is to set forth a complete history of the television series, This Is The Life, from 1952-1958, and to relate this to the history of the Lutheran Church-Missouri Synod, the sponsor, the history of evangelism, and the history of pertinent theology. The fact that this series is the most widely televised of any on the air is at least one point which makes its study important.

A standard program analysis formula was followed, "Who says what to whom, how, and with what effects?" Information on the history of the church, the history of evangelism and the history of theology was derived from a study of secondary source literature. The history of the program series was given in large measure by Mr. Melvin Schlake, executive secretary of Lutheran Television Productions, the producing agency within the Lutheran Church-Missouri Synod. Correspondence interviews were conducted with the filming agency, Family Films, Inc., of Hollywood, California, with Nelson Leigh, the actor who has played Pastor Martin throughout the series, and with Forrest Taylor, the actor who played Grampa Fisher during the first three and a half years of the series.

Four surveys were conducted to attempt to find out the reaction of the public to the program. A telephone survey was conducted in the Dexter-Pinckney, Michigan telephone districts yielding two hundred twenty respondents. Of that number, thirty-three were able to answer questions about the program.

The second survey involved interviewing personally the people who had written to the broadcast requesting literature. Only eight were located from the correspondence of the preceding eighteen months. A mere hint of what the total picture of this audience segment would be could be deduced from these. The results are included because of the interesting findings rather than because of their conclusiveness.

The third survey involved a questionnaire sent to the program manager of every station which aired the program as of the fall quarter, 1958. On this questionnaire, managers were asked to give comparative ratings of This Is The Life and other well known family-situation dramas. They

were questioned further about their attitude toward religious programming in general.

The fourth survey was also in the form of a questionnaire which was sent to a random sampling of pastors of Missouri Synod Lutheran Churches in cities where This Is The Life was being aired as of the fall quarter, 1958. These pastors were asked to rank the success of the program as they saw evidence for it in their parishes. This ranking was made on each point set forth in the goals of Lutheran Television Productions.

A composite audience profile was established from the responses to the telephone and personal survey. They were found to be mostly churched, and fairly regular in attendance, but only occasional viewers of the telecast. The distribution included eight Protestant denominations and Roman Catholics. However, only two respondents found anything doctrinal on the broadcast with which they disagreed. A significant segment of those interviewed were definitely disturbed by the thought that the pastor on the broadcast might be only an actor.

The results of the program manager's questionnaire indicated that This Is The Life is doing a good job for the stations. It is professionally produced and highly acceptable to the stations which air it. Some program managers had worthwhile constructive criticisms to offer.

The results of the pastor's questionnaire indicated that while the pastors themselves think highly of the program, there is little concrete evidence that the series has done much more for the local parish than be an excellent public relations factor. Nearly all the pastors polled regarded the good rapport which has been established as a result of the program as the main contribution which the sizeable investment of Synod has made to their individual ministries.

There were two principal areas of failure – that of the missing motivation in the episodes themselves, and the failure of the follow-up on the part of the local pastors. Recommendations for further study include a motivational research of this particular program's audience with a view to strengthening the moving factors in the program itself. The follow-up is a problem for the Lutheran Church-Missouri Synod, rather than for Lutheran Television Productions.

Microfilm $3.55; Xerox $12.40. 275 pages.

THE CRITICAL-BANDWIDTH LEVEL IN RECRUITING EARS AND ITS RELATION TO TEMPORAL SUMMATION

(L. C. Card No. Mic 61-1787)

George Reed Simon, Ph.D.
University of Michigan, 1961

The purpose of this study is to demonstrate the following: (1) the value of the critical-bandwidth level at a frequency where recruitment is present in cochlearly impaired ears as compared to the critical-bandwidth level for the same frequency in normal ears; (2) the relation between the size of the critical-bandwidth and log time for normal and cochlearly impaired ears; (3) the accuracy and reliability with which the measurements of the critical-bandwidth could be made.

In the present study there were nine normal hearing and nine recruiting subjects (at 4 kc) in each experimental group. Only one ear of each subject was used. The apparatus consisted of a signal and noise circuit which was used to obtain masked threshold measures.

Data were collected by testing each subject individually. Masked thresholds were measured at 1 and 4 kc in a white noise (100-6000 cps). These thresholds were measured for signal durations of 12.5, 25, 50, 100, 200, 400, and 800 msec. The masked thresholds were measured at spectrum levels of 52.5 and 62.5 db. These measurements were repeated for each subject during a second listening session.

The results were presented graphically and subjected to analyses of variance and tests of reliability.

The results show that at 4 kc, the recruiting group demonstrates a greater critical-bandwidth level for all durations than the normal hearing group. Further, that the time through which the ear can summate energy is restricted for the recruiting group as compared to the normal hearing group. These differences are not noticed between the groups at a frequency where recruitment is not present (1 kc).

The precision of the measures obtained at 800 msec. and the reliability of these measures was determined for each group at 1 and 4 kc. At 1 kc a significant difference among trials was present for both groups. This was explained by an increase in performance since the subjects were first tested at 1 kc. A high degree of reliability was obtained at both frequencies for both groups.

The results obtained at 4 kc for an 800 msec. signal duration indicate that if a patient's critical-bandwidth level is 3 db greater than that of the normal hearing subject's, the patient shows evidence of recruitment. No overlap was found between the normal hearing and recruiting group with respect to critical-bandwidth at 4 kc.

Microfilm $2.75; Xerox $3.60. 65 pages.

AN EMPIRICAL STUDY OF THE BEHAVIORAL CHARACTERISTICS OF SINCERE AND INSINCERE SPEAKERS

(L. C. Card No. Mic 61-1711)

John William Wills, Ph.D.
University of Southern California, 1961

Chairman: Professor Dickens

The purposes of this study were (1) to investigate the overt speaking behaviors of speakers making sincere speeches and the behaviors of the same speakers making insincere speeches and (2) to investigate the differences in the behavior of speakers judged relative to sincerity or insincerity by varying percentages of listening audiences.

Both rhetorical and experimental literature were surveyed to discover the descriptions of behaviors attributed to sincere and insincere speakers. No explicit descriptions of behaviors relative to sincerity as a dimension of ethos were found. Recent experimental studies indicated that audiences could not accurately judge the sincerity or insincerity of speakers.

Filmed speeches of 24 speakers, each delivering a speech supporting a proposition in which he sincerely believed and also a speech opposing the same proposition, were used as the basis of this study. These 48 filmed speeches had previously been viewed by audiences, and speakers had been judged as to their sincerity or insincerity. Observations relative to 120 items of behavior were recorded for each speech. Characteristics described included items traditionally associated with (1) physical behavior, (2) vocal behavior, (3) content, and (4) language and syntax. Tabulation of descriptive terms enabled comparisons between selected groups of speakers.

The total numbers of observations relative to each descriptive item were computed for all sincere speakers and compared with similar totals for insincere speakers. No distinguishing behavioral differences were revealed between the sincere speeches and insincere speeches. Changes in behavior between the sincere and insincere speeches of each speaker were tabulated, and percentages of the total number of speakers showing such changes were computed. Relatively few items showed changes in over two thirds of the speakers. Items relative to which observed changes could be interpreted as indicating worsening or improving speaking effectiveness were further analyzed by computing the percentages of speakers, showing improvement or deterioration. In no item were differences observed sufficiently distinctive to indicate a relationship to sincerity.

Further comparisons were made of the totaled observations for each item relative to three selected groups of speakers as follows: (1) speakers most often judged by audiences to be sincere, (2) speakers most often judged to be insincere, and (3) speakers concerning whose sincerity audiences could least agree. Inspection revealed distinctive differences between the behavior observed among the three selected groups. The six speakers most often judged by audiences to be sincere were found to hold in common behaviors relative to 23 items observed which were not also held in common by the other groups. The five speakers most often judged to be insincere held in common behaviors relative to 18 items observed which were not also held in common by the other groups. Speakers about whose sincerity audiences could least agree did not hold characteristics in common which were distinctive from the other groups.

The following conclusions seemed justified by the observations made in the study: (1) No distinctive differences in observed behavior were found between sincere and insincere speakers when classifications were made by the speakers themselves. (2) When speakers were classified as to sincerity or insincerity by audiences, several distinctive differences were found in observed behaviors between the groups. (3) Speakers most often judged sincere and speakers most often judged insincere were found to hold characteristics in common within each respective group which were distinctively different from the other group and which were not also held in common by speakers concerning whose sincerity or insincerity audiences were less decided. Microfilm $3.90; Xerox $13.75. 302 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

THE COMPARATIVE MORPHOLOGY OF THE MALE TERMINALIA OF NEUROPTERA (INSECTA).

(L. C. Card No. Mic 61-1211)

Thomas Stephen Acker, Ph.D.
Stanford University, 1961

In many adult insects the skeletal structures of the last four abdominal segments (segments eight, nine, ten, and eleven) are modified for reproductive purposes and referred to as the terminalia. More than 4000 terms have been applied to these structures in all insects, and for male Neuroptera alone the number exceeds 125. The investigation of male Neuroptera was undertaken to determine whether or not a common basic pattern prevailed in this group, and if so to suggest a structural plan applicable to the terminalia of many other insect orders. The male terminalia of approximately 72 genera representing 24 families of Neuroptera were examined and dissected after preparation in ten per cent KOH. The terminal structures are compared and illustrated (32 pages of illustrations).

It is hypothesized that the adult insect potentially could develop on each abdominal segment a dorsal plate (tergite), a ventral plate (sternite), and one pair of lateral appendages (coxopodites). The general agreement between this hypothetical condition and that actually found in male Thysanura is shown. Then, using only the structural elements of tergites, sternites, and coxopodites, an interpretation of the terminalia of male Neuroptera is presented.

8TH SEGMENT.—The eighth tergite and sternite are generally present and quite similar to the corresponding plates of the preceding segment. The coxopodites are fused with the eighth sternite and not evident as distinct plates.

9TH SEGMENT.—The ninth tergite is also generally present but often modified by a variation in size or a fusion with other plates. The ninth sternite, except in the suborder Raphidiodea and some Coniopterygidae, is the last ventrally placed sternite. The ninth coxopodites are characterized by their ability to change their relative positions in the course of evolution. They are found associated with the ninth sternite in some families and joined with the ninth or tenth tergite in others. Or they become one fused structure located between the ninth sternite and the anus; this latter condition prevails in the majority of neuropteran families and perhaps compensates for the loss of other ventral skeletal sclerites.

10TH SEGMENT.—The tenth tergite is generally the last plate of the dorsal abdominal region. Often it is divided mid-dorsally and appears as two plates. It is suggested that the sternites and coxopodites of this segment are more similar to their thoracic counterparts than to those of any preceding abdominal segment. This is due to the fact that nowhere else in the abdomen are leg appendages formed in close connection with the sternite; the close relation of legs to sternites is characteristic of the thoracic region. Thus the tissue of the tenth sternum is described as invaginating to meet the ejaculatory duct, and the sternite derived of this tissue (hypandrium internum) is modified in a way similar to a thoracic furca. A possible intersegmental sternite is found between the tenth and eleventh segments in several families of Neuroptera and this may be related to the thoracic sternite called the spinasternum.

11TH SEGMENT.—The eleventh tergite is either fused with the tenth tergite or lost. The eleventh sternite is present rarely and then only in a reduced state. The eleventh coxopodites appear as small raised warts called cerci, or as more reduced structures, each called callus cerci. The reduction of the structures of the eleventh segment follows the general arthropod evolutionary trend toward shortening of the abdomen.

This interpretation of male terminalia of the Neuroptera in terms of skeletal plates that are known to occur in insects is supported by evidence of the following sorts: (1) intermediate forms that bridge the gaps between the more diverse morphological forms; (2) the relationships of muscles to skeletal plates; (3) developmental data from other orders of insects; and (4) a display of continuity in basic morphological plan from one insect family to another, consistent with present concepts of evolution and adaptive radiation. Microfilm $2.75; Xerox $3.60. 61 pages.

SYSTEMIC ACTION OF TWO INSECTICIDES ON ARTHROPOD PARASITES OF RABBITS AND CATTLE

(L. C. Card No. Mic 60-3577)

Theodore Roosevelt Adkins, Jr., Ph.D.
Alabama Polytechnic Institute, 1958

Supervisor: Frank S. Arant

Experiments were conducted to determine the toxicity of Dipterex (Bayer L 13/59; 0,0-dimethyl-2,2,2-trichloro-1-hydroxyethyl-phosphonate) to nymphs of the Gulf Coast tick, Amblyomma maculatum Koch, which were attached to domestic rabbits that were subsequently dosed with the chemical. The statistical analysis of these data indicated that tick mortalities were not affected by the sex of the treated rabbits. The LD-50 (angle 45) was 36.0 milligrams of Dipterex per kilogram of body weight of rabbit. Mortalities of ticks were: on rabbits receiving 0 milligrams per kilogram, 0 per cent mortality; 25 mg /kg, 25.2 per cent; 50 mg /kg, 88.3 per cent; 75 mg /kg, 95.5 per cent; and 100 mg /kg, 100 per cent. Preliminary tests were also conducted to determine the systemic effect of Trolene,

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

(Dow ET-57; 0,0-dimethyl-0-2,4,5-trichlorophenyl-phosphorothioate) against nymphs of the lone star tick, A. americanum (L.). Two tick infested rabbits were treated with the chemical at the rate of 100 milligrams per kilogram of body weight. At this rate, Trolene exhibited no systemic effect against the ticks. All of the ticks that were attached to the Trolene treated rabbits engorged, dropped, and molted normally.

Investigations were conducted to study the systemic action of phosphorus-32 labeled Trolene in laboratory animals. Domestic rabbits were treated with the following levels of radioactive Trolene: 50,75,100, and 200 milligrams of chemical per kilogram body weight. Blood samples were collected from the marginal ear vein at intervals after the rabbits received the radioactive material. After drying, radiation from the samples was measured with the aid of a thin end-window Geiger-Muller tube. Simultaneously as blood samples were taken, groups of fifth-instar bed bugs were allowed to take blood meals from the treated rabbits. Percentage mortalities of these bugs were used for bioassay studies. Each rabbit responded differently to treatment with the radioactive Trolene. However, the reaction pattern of each animal to the chemical was similar. The quantity of radioactive material in the blood did not rise to a peak and level off as would be expected. Conversely, the quantity of radioactive chemical in the blood fluctuated. There were three or four peak concentrations of radioactive chemical in the blood. Bioassay with bed bugs also indicated fluctuating levels of a toxicant in the blood. The data indicated that the amount of radioactive chemical in the blood at any one time was not necessarily 100 per cent toxicant because the results of the radiological assay did not consistently correlate with the results of the biological assay. The fluctuations of the concentration of the radioactive material in the blood might have been the result of some mechanism that limited the absorption of chemical through the gut wall into the blood stream. When the concentration of the radioactive material in the blood reached high levels, bleeding was difficult, blood was more viscous and clotted faster than normal, and bugs fed slowly or did not feed at all. Rabbits died when the concentrations of the radioactive chemical in the blood reached the following levels: 18.6, 23.6, 41.6, 72.4, and 107.0 μg equiv. /ml.

Field experiments with Trolene (ET-57) for systemic control of the common cattle grub, Hypoderma lineatum (DeVill.), were conducted at four locations in Alabama in 1956. These tests involved 115 treated and 147 untreated animals. Some of the cattle were treated with boluses and some were treated with drench.

The following are percentages of grubs controlled in cows that were treated with boluses: Prattville, 80; Camden, 96; Marion Junction, 97; and Camp Hill, 94. Average control in these cattle was 87 per cent. Seventy-seven per cent of the animals treated with boluses and 22 per cent of the untreated animals were free of grubs at the completion of the tests. Cattle grub control based on number of grub-infested animals was 70 per cent where Dow ET-57 was administered as boluses.

In the cattle that were treated with drench, the percentages of control of grubs at Camden was 79 and at Marion Junction, 90. The average control in these cattle was 86 per cent. Seventy-six per cent of the animals that were drenched and 36 per cent of the untreated animals at these two locations were free of grubs at the completion of these tests. Control based on number of grub-infested cattle averaged 63 per cent in the two areas where the drench was used.

There was no apparent difference in the effectiveness of the bolus and drench treatments; however, the boluses were easier and safer to administer.

Microfilm $2.75; Xerox $6.60. 139 pages.

THE MICROCOMMUNITIES ASSOCIATED WITH CERTAIN PRAIRIE PLANTS

(L. C. Card No. Mic 61-1964)

Carl Theodore Brandhorst, Ph.D.
The University of Nebraska, 1961

Advisers: Irving Hill Blake and
Thomas B. Thorson

An attempt has been made to determine the biology of the members of the microcommunities associated with twelve common prairie plants: Amorpha canescens Pursh., Amorpha fruticosa L., Aster multiflorus Ait., Astragalus canadensis L., Carduus altissimus L., Helianthus annuus L., Lygodesmia juncea (Pursh.), Petalostemum candidum (Willd.) Michx., Psoralea tenuiflora Pursh., Rosa pratincola Greene, and Sideranthus spinulosus (Nutt.) Sweet, Vernonia baldwinii Torr.

In the case of Lygodesmia juncea Pursh. the greatest concentration of insects occurred in association with galls induced by Antistrophus pisum Walsh (Cynipidae). This insect was recovered from three different galls on this plant and two parasites from two of the galls.

Evidence was found indicating that Eurytoma neomexicana (Gir.) (Eurytomidae) is a constant associate of Sideranthus spinulosus (Nutt.) Sweet. This insect destroys about 56 per cent of the seeds. Neaspilota alba (Lw.) and Trupanea radifera (Coq.) (Tephritidae) as well as a new species of Trupanea were found infesting the heads of this plant.

While fifty-nine insects were found to be definitely associated with Amorpha fruticosa L. perhaps the most interesting group centered in the galls induced by Walshia amorphella Clemens (Gelechidae). Several parasites of this lepidopteron were studied as well as numerous insects which occupy the gall after the original gall-maker has emerged. Among the later occupants of the gall are the bee Hylaeus cressoni (Ckll.) (Colletidae) and the wasp Trypoxylon frigidum Smith (Sphecidae). The biology of Rhydinofoenus floridanus bradleyi Townes (Gasteruptiidae), a parasite of both Hylaeus and Trypoxylon is described. This is the first biological report on any member of the sub-family Gasteruptiinae in North America. A lepidopteron also encountered on Amorpha fruticosa L. is a recently described species Agonopterix dimorphella Clarke (Oecophoridae). This insect has been previously reported only from the original locality in Illinois. A coleopteron Bruchus sp. near exiguus Horn (Curculionidae) was found to feed on the seeds of Amorpha fruticosa L.

Fifty-three insects associated with Rosa pratincola Greene were studied. Of these the most common was Rhynchitis bicolor Fabr. which infests the hips of the rose.

Eight different galls were commonly found on Rosa pratincola in Seward County. From these four gall-makers, two inquilines, and thirteen parasites were cultured. One of these gall-makers and two parasites were also cultured from a gall on Rosa rugosa Thunb. This gall was easily distinguished from those on Rosa pratincola.

Aster multiflorus Ait. was studied in Seward County as well as in twenty-one places in western Nebraska and northeastern Colorado. Few insects are partial to this plant. Only an unidentified midge (Itonididae) and three of its hymenopterous parasites could be shown to be definitely associated with this aster.

Sixty-one species of insects are found definitely associated with Vernonia baldwinii Torrey. One hundred eighteen species associated with other plants are also listed. Microfilm $2.75; Xerox $6.00. 121 pages.

A CYTOCHEMICAL STUDY OF THE INSECT APICAL CELL

(L. C. Card No. Mic 61-1358)

James Keith Butler, Ph.D.
The University of Texas, 1961

Supervisor: T. S. Painter

The apical "cells" of representatives of three insect orders were examined by cytochemical methods in an attempt to determine the functions of this structure. Methods for the demonstration of DNA, RNA, proteins, and carbohydrates were used.

The apical structure of Bombyx mori (Lepidoptera) consists, for the most part, of the products of degradation of primary spermatogonia. Its very large atypical nuclear structure, while not polyploid, shows evidence of both RNA and protein synthetic activity. The cytoplasm immediately surrounding the apical nucleus also shows evidence of considerable protein synthetic activity.

The apical structure of Erax aurimystaceus (Diptera) appears also to be a product of the degradation of a large number of cells, so that, in the adult, it is a syncytium containing many small degenerate nuclei. The apical nuclei contain very little DNA and no nucleoli. There is no evidence of significant RNA or protein synthesis in any part of the adult apical structure of Erax. The suggestion is made that some of the prominant hematoxylin stainable material in the apical structure of Erax may be of a complex-lipoidal nature.

The apical structure of Melanoplus differentialis (Orthoptera) is a cell that has a moderately large nucleus but scant cytoplasm, and shows evidence of active nuclear RNA and protein synthesis.

Previous investigators have suggested that the apical structure subserves either a nutritive and/or a supportive (structural) function. The unique morphological and topographical relationship between the apical structure and the primary spermatogonia and the localization of the gonial mitochondria in parts of the cell most intimately associated with the apical structure indicate that the apical structure is elaborating substances to the surrounding primary spermatogonia. The prominant synthetic mechanisms present in the apical structures of Bombyx and Melanoplus are not typical of cells or structures that function only as supportive elements.

The cytochemical evidence is against either polymerized DNA or RNA being provided to the spermatogonia by the apical structure. The apical structure of Erax is the only one in which there is evidence that significant quantities of polysaccharides are in a position to enter the spermatogonia. It is concluded that the nutritive products of these apical structures are most probably the compartively small molecular fragments of degraded cells that may or may not be reprocessed by the synthetic mechanisms of the apical structures or, in the case of Melanoplus, the nutritive products are similar small compounds that are synthesized directly by the apical structure. It is pointed out that while an auxiliary nutritive mechanism that involves the degradation of whole cells is an inefficient mechanism, it is not uncommon in the reproductive mechanisms of both plants and animals.

Microfilm $2.75; Xerox $4.40. 82 pages.

REDUCED INTERSPECIFIC COMPETITION IN THE BIRDS OF BERMUDA

(L. C. Card No. Mic 61-2026)

Kenneth Leland Crowell, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Robert H. MacArthur

One way of obtaining evidence for the role of interspecific competition is to study the nature of changes occurring in its absence. Competition would seem to be reduced in the few passerines of Bermuda, which include several species also found in the larger North American avifauna. With this point in view, a comparison of the ecology of Bermudian and North American populations of three such species was made.

Avian populations in Bermuda are of the order of half-again as dense as those of comparable continental habitats. Of the ten common resident land birds, the catbird (Dumetella carolinensis), cardinal (Richmondena cardinalis), and white-eyed vireo (Vireo griseus) compose eighty per cent of these populations, and the three species are thus far more common than in any North American habitat. These data strongly suggest that the populations of different species in a fauna are not independent, but interact. And while the populations of individual species depend on the number of competing species, the total population of a fauna is not dependent on the number of species composing it, but is an expression of the carrying capacity of the habitat.

However, absence of competition would seem unable to account entirely for population densities which are greater than those of the mainland. It is unlikely that more energy is available to birds in Bermuda, or that greater specialization is achieved. It is suggested that in a more moderate environment less energy is required to sustain life, population-specific mortality is thus lower, and this combined with a lower turnover allows a greater population to be supported.

The high densities of the few Bermuda species must in part be attained through use of foods ordinarily utilized by

the missing species. However, the ranges of feeding methods and feeding heights utilized by the cardinal, catbird, and white-eyed vireo in Bermuda were no greater than in North America, although the apportionment of feeding time within the limits of these ranges was different. The cardinal and catbird spent more time at ground-feeding in Bermuda, but the feeding of only the vireo was of greater diversity. Size and shape of the bill were different in Bermuda in all three species, but the adaptive advantage of such differences is not clear. Variability of Bermuda measurements was greater in the catbird, but less in the other two species, and thus did not support the hypothesis of more diverse feeding habits existing in Bermuda.

Nesting habitats in Bermuda were among those types occupied in North America, although they were not those which are most preferred there. With the high density of the Bermuda species, territories were more closely-packed, apparently as a result of greater tolerance in site selection allowed by the smaller number of species. Nesting in Bermuda also took place in sparser, more brushy habitats than on the mainland.

It is seen that exploitation by the Bermuda species of food and habitats relinquished by absent competitors has been accomplished through application of innate behavioral patterns to new situations. Niches, or conditions to which species are adapted, are therefore broadly-overlapping, rather than discrete. This does not invalidate the Volterra-Gause Principle, for ecological separation need not be complete to allow coexistence.

Random colonization as limited by distance from the source area is not sufficient to account for the few Bermuda species. While the success of these species in establishing themselves must be related to the particular types of habitat found in Bermuda, these habitats appear no better suited to the Bermuda species than to several others which do not breed there. Factors determining which species are successful thus remain obscure.

Microfilm $2.75; Xerox $3.00. 56 pages.

STUDIES OF THE METABOLISM OF THE EPIDIDYMIS OF THE MOUSE

(L. C. Card No. Mic 61-1737)

Paul Russell Elliott, Ph.D.
University of Michigan, 1961

As a basis for further investigations of the physiology of the epididymis, the present study was concerned with an evaluation of some of the in vitro metabolic characteristics of the epididymis under normal and androgen varied conditions.

Optimal conditions were ascertained for the measurement of total respiration and glycolytic activity by homogenates of epididymis and kidney. Respiratory activity was measured manometrically in a Warburg apparatus. Glycolytic activity was estimated by quantitative, colorimetric analysis of the lactate accumulation and phosphate esterification in fluoride blocked homogenates.

Homogenates of kidney respired at a high rate (18 μMoles of oxygen taken up / mgm total nitrogen / hour) on a simple medium composed of buffer, inorganic phosphate, nicotinamide and substrates (glucose, pyruvate, fumarate and glutamate). The highest rate of oxygen uptake obtained in homogenates of epididymis (4 μMoles of oxygen taken up / mgm total nitrogen / hour) was on a medium identical to that used for kidney with the addition of ATP, DPN, cytochrome c and succinate. Studies with varied substrate oxidation indicated a possible low step or block in Krebs cycle activity in homogenates of epididymis.

Results with experiments using DNP, ADP, fluoride and altered concentrations of inorganic phosphate indicated a good balance between phosphorylative and dephosphorylative reactions in respiring kidney homogenates. Homogenates of epididymis responded to these alterations in a manner suggestive of a low in vitro oxidative phosphorylative activity.

The rates of anaerobic glycolytic activity with HDP as substrate were of a comparable order in homogenates of both epididymis and kidney. Under the conditions imposed in these experiments, homogenates of kidney were incapable of phosphorylating glucose or fructose. Epididymal homogenates retained this capacity in the presence of catalytic amounts of HDP, and as a result, maintained a net phosphate uptake during the period of anaerobic phosphorylation.

Aerobic glycolysis in homogenates of kidney, on the medium which was optimal for anaerobic glycolysis, resulted in a rate of lactate accumulation 10-15% lower than that observed under anaerobic conditions. This inhibition was accentuated by added fumarate or removal of inorganic phosphate, and was relieved by the addition of fluoride or DNP. The accumulation of lactate in homogenates of normal epididymides was unchanged under any of these aerobic conditions of incubation.

No effect of vasectomy or in vivo androgen variation was observed on homogenates of kidney with respect to glycolysis or oxygen uptake.

A lowered respiratory rate (25-30%), observed in homogenates of epididymides removed from vasectomized mice, was found to be due to the loss of sperm in the vasectomized state. A similar effect of vasectomy on the anaerobic glycolytic activity of epididymal homogenates appeared to be due to an inhibition of the glycolytic system in the epithelium of the epididymis, rather than to the absence of sperm. On the basis of the results obtained, the inhibition was placed at the lactic dehydrogenase step.

Effects beyond that of vasectomy of castration and in vivo testosterone variation on glycolysis and respiration were not detected in homogenates of epididymis.

These results were discussed in terms of the physiology of the epididymis and its relationship to sperm maturation and maintenance. In particular, it was suggested that the results of the present study and the results of the work of other investigators on this tissue would be compatible with an hypothesis of a noncompetitive metabolism between the epithelium of the epididymis (predominantly glycolytic) and epididymal spermatozoa (predominantly oxidative). As a means by which a maintenance metabolite could be accumulated for use by epididymal spermatozoa, this situation would be analogous to the situation between the seminal vesicle and ejaculated sperm regarding fructose.

Microfilm $2.75; Xerox $5.80. 118 pages.

THE ANTI-INSULIN ACTIVITY OF HEPARIN

(L. C. Card No. Mic 61-2030)

Samuel Allan Ferguson, Ph.D.
University of Pennsylvania, 1961

Supervisor: Niels Haugaard

A number of substances have been reported to antagonize the hormonal activity of insulin. Such action has been ascribed recently to heparin, an anticoagulant agent. The mechanisms proposed to explain this antagonism, however, are conflicting. The object of this study is to determine the manner in which heparin suppresses the action of insulin and to elucidate the basic factors involved.

Two parameters of insulin activity have been employed to investigate the relationship between insulin and heparin. The first parameter studied was hypoglycemic convulsions. These convulsions, which may result from insulin-stimulated glucose uptake, have been studied in relation to the affect of heparin upon their onset. Mice and adrenalectomized rats were used as test animals.

The second parameter of insulin activity investigated in relation to heparin activity was the glucose uptake of isolated diaphragms (rat). Prior to incubation in a glucose medium, these tissues were incubated in various insulin and heparin solutions. The comparative rates of glucose disappearance from the incubation medium have been followed to define the anti-insulin effect of heparin.

The administration of heparin prior to or concurrent with insulin injections delayed the onset of insulin-induced convulsions in both mice and rats. The magnitude of this delay, however, was dependent upon both the route and time of heparin administration (as related to insulin injection). When incubation mixtures of insulin and heparin were given, a greater delay in the onset of insulin-induced convulsions was observed.

The observation that heparin is capable of suppressing insulin activity in adrenalectomized animals suggests this activity is not mediated by epinephrine, but is possibly due to a direct heparin effect. The latter postulation is further supported by the results obtained from the glucose uptake studies. Although insulin is present, the glucose uptake of rat diaphragms incubated in insulin-heparin mixtures is not increased. Pre-insulin heparin incubation of these tissues also inhibits the stimulatory effects of insulin on their glucose uptake.

The results of this study indicate that heparin possesses anti-insulin activity. Two modes of action are thought responsible for this activity: 1) chemical alteration of the insulin molecule by heparin, and 2) possible heparin blockade or alteration of tissue insulin receptor sites. Since incubation of tissues with insulin-heparin mixtures significantly inhibits the action of insulin, a chemical union or binding of these may occur. The manner in which these substances are combined is not known.

Microfilm $2.75; Xerox $3.00. 45 pages.

BEHAVIOR OF THE AMERICAN REDSTART, SETOPHAGA RUTICILLA (LINNAEUS).

(L. C. Card No. Mic 61-1437)

Millicent Sigler Ficken, Ph.D.
Cornell University, 1960

This study is an analysis of the maintenance activities, agonistic, and sexual behavior of the American Redstart. Displays are analyzed in terms of causation, function, and biological significance.

The maintenance activities of this species were studied in some detail. These movements are usually quite stereotyped. The ontogeny of such activities as stretching, scratching, and sleeping postures is marked by gradual changes.

Most of the agonistic behavior falls into two general categories: those activities concerned with the defence of individual distance and the defence of an area (territory). In many instances the displays associated with the defence of individual distance are different from those associated with territorial establishment and defence. The fact that there are several displays common to both contexts indicates that territory and individual distance are causally related.

Males defend an area of about an acre against intruding males, while females defend the territory only against intruding females. Thus there is a division of labor between the sexes with regard to the defence of territory. In addition to the females' participation in the defence of the territory as a whole, they also react aggressively toward certain categories of intruders in the nest area.

There are many visual and vocal displays which are associated with territorial defence by males. Those displays which are confined to the boundary zone between adjacent territories are ones which seem to reflect an attack-escape balance. On the other hand when conspecific intruders come within the territory, resident males usually react with attack or with displays showing a strong attack tendency. Thus the reaction of males are dependent both on their positions in relation to the territory and to a lesser extent, to the reaction of the other male.

There are two song types, each of which seems to have a different motivation. The frequency of song types changes during the reproductive season, and the type which seems to express a weaker attack tendency becomes proportionately more common later in the season. The possession of more than one song type is widespread in the Parulidae.

Courtship encompasses the relations of the pair from their initial contact through the copulation period. The pair formation period in this species is marked by aggressive approaches by the male, in response to which the female flees but does not leave the territory. As the season progresses, the attack tendency of the male decreases while his sexual tendency increases. On the other hand, the attack tendency of the female increases slightly, and her sexual tendency also increases.

The precopulatory displays of the male are a result of the conflict of sexual and escape tendencies. The male displays are variable and include many different elements. Courtship displays are first noted during nest site selection, and these reflect a low sexual tendency in conflict with the escape tendency. The typical form of the male precopulatory display changes during nest building and the later displays reflect an increased sexual tendency in

conflict with a stronger escape tendency. Male displays may stimulate soliciting by the female. Copulation only occurs when both sexes have a strong sexual motivation not in serious conflict with incompatible motivations. Either sex may initiate copulation. If the female solicits, the male may approach and mount without preliminary displays. Microfilm $2.75; Xerox $7.80. 166 pages.

CYTOLOGY AND METABOLISM OF THE FLIGHT MUSCLE SARCOSOMES DURING THE HONEYBEE (APIS MELLIFERA L.) DEVELOPMENT.

(L. C. Card No. Mic 61-2038)

Richard Carl Herold, Ph.D.
University of Pennsylvania, 1961

Supervisor: Hans G. Borei

A study was carried out on some aspects of the cytology and metabolism of the indirect flight muscle sarcosomes of the honeybee (Apis mellifera L.) worker during the postembryonic and imaginal development.

The cytology was studied using standard electron microscopic procedures. Respiratory metabolism was investigated by means of a polarographic technique for oxygen. The cytochrome system during development was studied using difference (oxidized vs. reduced) spectra obtained with a recording split-beam spectrophotometer at liquid nitrogen temperature (-196°C).

The indirect flight muscle sarcosomes of the honeybee appear to originate from rod-shaped precursors located in the interfibril sarcoplasm. The cytological differentiation, which occurs in the last three days of the pupal period, consists of a swelling of the precursors and the formation of an internal packed lamellar structure. The sarcosomes increase dramatically in size, weight, and enzyme content during the following adult maturation period.

The rod-shaped sarcosome precursors contain cytochromes $\underline{a}_3$(-band, 445 mμ) and $\underline{a}$ (α-band, 598 mμ)which may be associated for electron transport with cytochrome $\underline{b}_5$ (α-band, 552-560 mμ). The substrate utilized during this stage probably originates from the fat body cells. A dramatic change in identity and amount of cytochrome components accompanies the differentiation of the sarcosomes from the rod-shaped precursors. Cytochrome $\underline{b}_5$ becomes undetectable by the 11th pupal day and components $\underline{b}$ (α-band, 561 mμ) and $\underline{c}_1$ (α-band, 552 mμ) appear. Cytochromes $\underline{a}_3$ + $\underline{a}$ increase in concentration. Cytochrome $\underline{c}$ (547 mμ) appears for the first time on the first imaginal day. Cytochrome components $\underline{a}_3$ + $\underline{a}$ are present in the sarcosome precursors in approximately equal amounts. They appear to increase in amount as a unit. Cytochromes $\underline{b}$ (α-band, 561 mμ) and $\underline{c}_1$ (α-band, 552 mμ) appear by de novo synthesis in approximately equal amounts and thereafter increase at the same rate.

Cytochrome $\underline{c}$ also seems to be synthesized de novo; its synthesis follows a rate independent of the other components. Thus it appears that the cytochrome components of the final (adult) system are formed in three distinct units. The system for metabolizing succinate does not appear to be present, or alternatively, not functionally connected to the adult-type cytochrome system until the final stages of adult maturation. This appearance coincides with the beginning of active foraging flights. During the early stages of imaginal maturation the α-glycerophosphate pathway, which is connected to the adult type of cytochrome system, can apparently provide sufficient energy to allow the flight muscles to move the wings in fanning motions.

A scheme of respiratory metabolism in the adult flight muscle is postulated.

Microfilm $2.75; Xerox $4.80. 92 pages.

STUDIES ON HOLOTHURIAN COELOMOCYTES WITH SPECIAL REFERENCE TO CUCUMARIA MINIATA

(L. C. Card No. Mic 61-1321)

Howard Roy Hetzel, Ph.D.
University of Washington, 1960

Chairman: Dr. D. L. Ray

A survey of the literature revealed that nine types of holothurian coelomocytes have been described; these were: hemocytes, amoebocytes, morula cells, lymphocytes, crystal cells, "brown bodies," minute corpuscles, fusiform cells and vibratile cells. Of these nine, only six (hemocytes, amoebocytes, morula cells, lymphocytes, crystal cells, and "brown bodies") were found to be normally present in the coelomic fluids of the eleven species of holothurians in the present study. Minute corpuscles and fusiform cells were assumed to be artifacts produced by the cytolysis of coelomocytes and the fragmentation of body tissues respectively. Vibratile cells were believed to be cells foreign to the coelomic fluid, perhaps symbiotic or free living flagellates.

Hemocytes were limited to holothurians belonging to orders Dendrochirota and Molpadonia. Amoebocytes, morula cells, lymphocytes, and "brown bodies" were found in all eleven species studied and were believed to be present in all holothurians. Crystal cells have not been found in order Apoda.

Coelomocytes were found in all the coelomic compartments of the eleven species of holothurians with the exception of the hyponeural canals where none were found. Any coelomocyte type may be present in any of the coelomic compartments. Only crystal cells were never observed in the hemal system of holothurians. Morula cells and amoebocytes were also found in the connective tissues of the body wall and viscera of holothurians.

Hemocytes contained hemoglobin and were possibly involved in the transport or storage of oxygen. Amoebocytes were normally in the petaloid state in the coelomic cavities of holothurians, but changed to the filiform state during clot formation or when removed from the body of the animal. Clots were formed by the fusion of filiform amoebocytes that produced a mesh in which other coelomocytes were trapped. The clotting mechanism of the holothurians tested was calcium-independent.

Lymphocytes represented stem cells that differentiated into hemocytes, amoebocytes, and morula cells. At

least a portion of the lymphocytes were derived from the mesenchymal cells in the connective tissue of the hemal vessels.

Brown bodies represent aggregations of amoebocytes filled with yellow refractile granules. Brown body material was accumulated in the anterior portions of the water vascular system, in the posterior portion of the perivisceral coelom, and in the walls of the respiratory trees where it was eliminated from the body by diapedesis. Carbon injected into the perivisceral coelom was eliminated from the holothurian body in a manner identical with that of brown bodies.

Starvation caused a decrease in the number of morula cells present in the connective tissue layers of holothurians and in the amount of eosinophilic material in the hemal vessels, but increased the amount of brown body material produced by the animal. The body tissues of a starving holothurian degenerated while the coelomocytes free in the coelomic fluid remained apparently unaffected. The colorless spherules in morula cells had an outer polysaccharide shell surrounding an inner protein core. Morula cells may be involved with protein synthesis and storage.

The yellow refractile granules found in hemocytes, amoebocytes, and brown bodies were believed to be a lipofuscin of the ceroid type. The refractile granules in hemocytes were formed by or derived from mitochondria.

The source and nature of the crystals contained in crystal cells remains completely unknown.

Microfilm $2.75; Xerox $9.45. 208 pages.

CRYPTIC SPECIATION IN THE HYLA VERSICOLOR COMPLEX

(L. C. Card No. Mic 61-1366)

Fred Clifford Johnson II, Ph.D.
The University of Texas, 1961

Supervisor: Dr. W. Frank Blair

Populations of treefrogs that have passed under the name Hyla versicolor show two call-types distinguished by the number of trills per second. The fast call-type has a range of 34 to 69 trills per second, and the slow call-type has a range of 17 to 35 trills per second for non-environmental-corrected data. Evidence available suggests that the effect of environment on the call character of trill rate is negligible. No significant differences were found for the call characters of duration and dominant frequency.

Reciprocal crosses between frogs of the two call-types showed a significant reduction of viability in comparison to the control crosses expressed by lower per cent fertilization, a high incidence of exogastrulation, and a high larval mortality during the first fourteen days after hatching. This phenomenon exists between the call-types in the area of sympatry and for populations separated by over 900 miles. F_1 males from each reciprocal parental combination were backcrossed to females of both call-types. The mortality of these backcrosses was 100 per cent by the fourteenth day after hatching.

The frequency distribution of the number of larvae to die per day for the reciprocal parental crosses was significantly different between the two combinations. The larvae from the fast call-type ♀ x slow call-type ♂ died earlier than the larvae of the reciprocal cross. A similar comparison of the larval mortality from the F_1 male backcross showed that the peak of the mortality occurred later in time when the F_1 male was backcrossed to a female of the same call-type as its mother than for a backcross to a female of the opposite call-type. These observations possibly indicate a reflection of Haldane's rule.

The adults were compared morphologically for their snout-vent length, femur length, and tibia length. The adult males of the slow call-type were significantly larger than the fast call-type adult males in their snout-vent length. The fast call-type adult males were significantly larger than the slow call-type adult males in the tibia length/femur length ratio.

The two call-types are shown to behave as two separate biological species. Due to the call-type at the type localities of the previously described subspecies, H. v. chrysoscelis is elevated to H. chrysoscelis. H. versicolor is retained for the slow call-type. Isolation mechanisms known to exist between these two species include hybrid inviability, hybrid breakdown, and ethological isolation.

A preliminary study of the geographic distribution indicates that H. versicolor is generally a northern species which extends south in the Appalachian Mountains and apparently has a disjunct population in eastern Texas and eastern Oklahoma. H. chrysoscelis occurs throughout the coastal plain and south-central Texas north to Minnesota and Wisconsin. Microfilm $2.75; Xerox $6.20. 126 pages.

A MONOGRAPH OF THE GENUS BELOSTOMA (HEMIPTERA)

(L. C. Card No. Mic 61-1635)

David Robert Lauck, Ph.D.
University of Illinois, 1961

This taxonomic monograph of the genus Belostoma includes keys, descriptions, and distribution for the 61 species treated. Of these, 16 are described as new, and eight neotypes, eight lectotypes, and syntypes for six species are designated. Types of 13 species, in addition to the types of those described as new, were examined.

The names of previously described species that can not be recognized from their original descriptions and are without types are treated as nomina dubia. This designation eliminates the former confusion and disagreement concerning the nomenclature of several species, hence will help stabilize the classification.

Large numbers of specimens, examination of numerous types, and utilization of the male genitalia as a taxonomic character have made possible a more valid interpretation of species than heretofore. The large number of specimens identified and recorded also helped to more clearly establish the intra- and interspecific variations of characters. Several characters, such as color, shape of pronotum, and size, which were formerly regarded as quite significant, are here regarded as of minor importance. The distribution, although often poorly known

for South American species, is more comprehensive than in previous monographs of this group.

One of the more important aspects of this monograph is the establishment of species groups. The 16 species groups are based almost exclusively on the characters of the male genitalia. These smaller distinct units permit specific comparisons between the relatively few members of the various groups, rather than comparing the many species of the entire genus. In some cases species, that were confused with one another in previous studies, belong to different groups, hence are now readily determinable by the structures of the male genitalia.

The taxonomic references for the species are cited at the beginning of each description. New synonymy or changes in the synonymy are given for several species.

Although Belostoma are of no direct economic importance, they are an important component of many ponds. They are encountered in ecological studies of ponds and lakes and have been used for anatomical, physiological, and embryological studies. It is hoped that this monograph will aid future studies by facilitating the determination of specimens obtained by collectors.

Microfilm $3.05; Xerox $10.60. 233 pages.

A STUDY OF THE EPITHELIOID MEMBRANES OF SOME FRESH WATER SPONGES

(L. C. Card No. Mic 61-1852)

Donald Nelson Mercer, Ph.D.
University of South Carolina, 1961

An investigation designed to study the differentiated epithelia of the adult fresh water sponge was undertaken. Living sponges were collected in their natural habitat; were brought into the laboratory and were permitted to become acclimatized to the laboratory conditions. They were tied on to glass slides, placed in water taken from their habitat, and were grown on this artificial substratum for periods of time sufficient to permit them to adhere to the slides, and for differentiation of tissue to take place. The sponges attached to the slides were then subjected to various treatments intended to demonstrate the construction of their epithelioid membranes. The principal technique used was treatment of the differentiated tissue with silver nitrate in an effort to establish the existence of cell boundaries by impregnation of the intercellular substances employing the reduction of the silver salts in direct sunlight. The tissue thus treated was stained for the purpose of nuclear differentiation. The treated and stained sponges were then subjected to critical microscopic examination, and were photographed.

On the basis of the demonstrated evidence produced by the experimental methods employed, it is concluded that the surface and basal epithelium, as well as the epithelium lining the subdermal canals is constituted of flattened epithelial cells, irregularly polygonal in shape, and varying from eight to thirty microns at their widest points. These epithelial cells possess intercellular materials in which silver nitrate is precipitated. They may be either mononucleate or polynucleate in structure. The mechanism whereby the multinuclear condition is produced remains unexplained.

Microfilm $2.75; Xerox $3.00. 47 pages.

GEOGRAPHICAL DISTRIBUTION OF THE UNIONIDAE (FRESH-WATER MUSSELS) IN KANSAS. (VOLUMES I AND II).

(L. C. Card No. Mic 61-284)

Harold Dixon Murray, Ph.D.
University of Kansas, 1960

Fresh-water mussels were studied in order to determine the kinds, their numbers, and their geographical distribution in Kansas. Except for rivers in the southwestern part of the state, all major river systems in Kansas have been sampled at least once since 1956.

Forty-one species and subspecies, representing 24 genera, of mussels occur in Kansas. Two species, Cyprogenia aberti and Dysnomia triquetra, have not been recovered in Kansas streams since 1906, but may yet occur in areas not sampled in the course of the study here reported on. Proptera capax and Arcidens confragosus are for the first time reported from Kansas.

All but two of the 41 species and subspecies of mussels occur in the Neosho and Verdigris river systems. Twenty-nine species and subspecies occur in the Marais des Cygnes drainage, 22 in the Kansas River drainage, but no more than 20 kinds occur in the Arkansas River drainage. All 41 species and subspecies occur east of the 98th meridian (slightly west of Hutchinson, Reno County, and slightly east of Beloit, Mitchell County), but no more than eight species inhabit waters west of 98° west longitude. The kinds and numbers of mussels decrease from the southeastern to the northwestern and southwestern portions of Kansas.

Rivers flowing across the sandy western portions of the state (High Plains) have few kinds and small populations of mussels, but there is a slight increase in the kinds and numbers of mussels in those same rivers as they flow across the Central Lowlands. Those rivers originating in the Central Lowlands (Neosho, Verdigris, and Marais des Cygnes rivers) have large populations and a diverse unionid fauna. The numbers and kinds of mussels present in a river system are strongly affected by the kinds of rocks prevalent on the terrain that the system drains. Stream bottoms of shifting sand severely restrict all species of mussels.

On the basis of the knowledge of the Pliocene and Pleistocene drainages--flow was eastward or southeastward--and on the basis of current knowledge of the present day unionid fauna of Kansas, it is concluded that the unionids of Kansas originated in the Mississippi River Valley. Most of the species in Kansas have a ubiquitous distribution in central North America. It was earlier thought that the unionid fauna of Kansas had strong southern affinities. Actually only two (Cyprogenia aberti and Proptera purpurata) of the 41 kinds occurring in Kansas are derived from the southern faunal assemblage. It is obvious, therefore, that Kansas includes only the extreme northern periphery of the range of the southern fauna.

Because Kansas is trans-Mississippian and at the western periphery of the fauna of the Mississippi Valley, because the probable center of dispersal of mussels of the Mississippi Valley was situated east of the Mississippi River, and because inadequate collections are available from the region between Kansas and the eastern center of

dispersal, several specific and subspecific relationships are not yet clearly understood. For example, interspecific relationships in Lampsilis, Pleurobema, and perhaps other genera are not adequately understood. As a result of the study here reported on, the relationship of the members of the genus Crenodonta are better known than they were previously. On the basis of specimens obtained from the Neosho and Marais des Cygnes rivers, it is concluded that Crenodonta peruviana peruviana intergrades in the upper reaches of large rivers with C. p. costata. Intergrades were previously regarded as a third species.

Several species, Ligumia recta latissima, Lampsilis anodontoides anodontoides, Plagiola lineolata and members of the genus Pleurobema, to mention a few, have decreased in numbers since 1906. Three species, Anodonta suborbiculata, Obovaria olivaria, and Ptychobranchus fasciolare, have probably been extirpated. The extirpation of these species and the decrease in numbers of individuals of several other species have resulted from industrial pollution and increasing siltation of the streams of Kansas. In order to preserve our mussels, which constitute an important and valuable resource of Kansas, there is need for immediate controls that will eliminate industrial pollution and that will lessen siltation.

Microfilm $4.15; Xerox $14.65. 323 pages.

STUDIES ON THE BAY SCALLOP, AEQUIPECTEN IRRADIANS CONCENTRICUS SAY, IN ALLIGATOR HARBOR, FLORIDA

(L. C. Card No. Mic 61-1293)

Akella Narasimha Sastry, Ph.D.
The Florida State University, 1961

The present investigation included the study of the ecology and reproduction of bay scallop Aequipecten irradians concentricus Say in Alligator Harbor and variations within populations of the species from different geographical areas. A morphological comparison was made with a closely related species Aequipecten gibbus Dall. The study also included an analysis of host-commensal relationship of bay scallops and pea crabs.

The bay scallops on Bay Mouth Bar, Alligator Harbor were observed in the years 1957 and 1958 to be most abundant during December-February and June-August. The population of mature scallops is reduced by late summer by extreme summer temperatures and predation and young scallops from the summer spawning appear on the bar, beginning by November. All scallops leave the bar by late February and March. Only scallops from the previous summer's spawning repopulate the bar, beginning in late May. Thus the normal life span of scallops is less than two years. In the spring of 1959, despite a heavy population on the bar in February of the previous summer's spawning, there was very little population. Low scallop productivity on Bay Mouth Bar, in the spring and summer of 1959 appears to be due to the dispersal, variable current pattern, mass transport and tidal wash.

Scallops in Alligator Harbor commenced gametogenesis before the beginning of winter but maturation was arrested during winter months. Development of gonads was resumed with rise in water temperature, in late spring and early summer. The scallops reached maturity by the end of July when the annual water temperature was maximum and they spawned with the decrease in water temperature in August. The peak spawning was in August and September but extended till the beginning of winter. Laboratory experiments on spawning supported field observations in requirement of lowered temperature stimulus to induce spawning after an initial elevation of temperature. The spawning does not seem to be restricted to a critical temperature. It seems exogenous factors control the ripening of gonads and spawning behavior of scallops.

Scallops were spawned in the laboratory and larvae reared three months past metamorphosis. The embryonic, larval and post-larval stages are described. Larvae settled on the 17th day and attained ribs characteristic of the adult on 32nd day from the time of fertilization, when cultured in the laboratory at 24.5°C.

Accompanying the morphological differences, the physiological requirements for reaching maturity and spawning were different for northern and southern subspecies of bay scallops. The larval and post-larval development of bay scallops from Alligator Harbor was slower at 24.5°C as compared to northern bay scallops observed at northern temperatures (14-16°C).

A. irradidians Lamarck and A. gibbus Dall are difficult to differentiate by morphological characters alone. While both the species can be distinguished by some visual characters, shell dimensions and rib counts overlapped. The distribution and habitat of each species is different.

The bay scallop is host to the commensal crab, Pinnotheres maculatus Say, which lives within the mantle chamber. The average size of the scallops infested with crabs was smaller than those without crabs. Experimental analysis of host-commensal relationship with a choice apparatus showed that the crabs were attracted to the host by some diffusible substance released by the host animal. The crabs removed from scallops showed greater attraction to a second molluscan host Atrina rigida Solander. Experiments suggested that crabs were not host specific to host scallops and that Atrina released a more effective attractant. Microfilm $2.75; Xerox $6.00. 125 pages.

LABORATORY EXPERIMENTS IN FISH PREDATION AS EXEMPLIFIED BY DANIO MALABARICUS (JERDON)

(L. C. Card No. Mic 61-1796)

Charles Steinmetz Jr., Ph.D.
University of Michigan, 1961

The general objective of this study was to identify and quantify variables that influence predation in fishes under closely controlled laboratory conditions. Most of the experiments were performed with the giant danio, Danio malabaricus (Jerdon), as the predator. Predatory ability was investigated under different physical and biological conditions. Primary physical factors tested were: (1) light and darkness (Experiment II); (2) distribution, character and density of cover (Experiment IV). Principal biological factors tested were: (1) training (Experiment I); (2) sense mechanisms involved in the capture of prey (Experiment III).

In addition, the feasibility of establishing a basis for systematic and controlled analyses of fish behavior was investigated.

Two different prey animals were employed for the majority of trials–young guppies, Lebistes reticulatus (Peters) and adults of the cladoceran, Daphnia magna (Straus). In a few trials, adults of another cladoceran, Simocephalus serrulatus (Koch), were used as prey.

Danios were exposed to the laboratory situation for two weeks to three months prior to experimental treatment. Predators were experienced to feed on prey organisms. No animal was employed experimentally until it had eaten a minimum of three of the prey subsequently to be used. After initial exposure to prey animals, predators were placed into the appropriate experimental environment for a 5-day starvation period before feeding. Most trials were made during 24-hour periods of possible predation. A few trials were made during 2-hour periods. The Mann-Whitney U test was employed for all statistical analyses. In addition, the Kruskal-Wallis one-way analysis of variance by ranks was employed where analyses among three or more independent samples were required. The level of significance, $\alpha = 0.05$, was applied in all tests.

The same mean numbers of D. magna prey were eaten in darkness and in light. Statistically significant differences were obtained between predation in light and in darkness using young guppies as prey. The numbers of D. magna eaten were not reduced after the removal of the eyes or mutilation of olfactory receptors of the danios. Cover, regardless of type, distribution, or density (to about 25 percent) was not effective in increasing the survival of D. magna prey. Conversely, cover was found to be effective in increasing the survival of young guppies.

General conclusions are: (1) the giant danio must be initially trained to young guppies for a considerably longer period of time than to D. magna prey before uniformly successful captures are made; (2) sight appears to be the sense primarily utilized for the capture of quickly moving prey by the predator; (3) survival of young guppy prey is significantly increased in darkness and in cover regardless of type, distribution or density (above a density of 25 percent); (4) cladoceran prey survival is not significantly increased in darkness or in cover.

Microfilm $2.75; Xerox $4.40. 83 pages.

TRANSPLANTATION IMMUNITY IN THE NEWBORN RAT

(L. C. Card No. Mic 61-2068)

David Steinmuller, Ph.D.
University of Pennsylvania, 1961

Supervisor: R. E. Billingham

The present investigation comprises a series of studies on the extremely critical period of maturation of the transplantation immune response in rats just after birth, for it is known that newly born and very young rats are highly tolerance-responsive to a variety of cellular antigens. Studies have been made on the suitability of the newborn rat as a host for the temporary survival and differentiation of foreign tissue; the postpartum maturation of the ability to respond to various types of grafts has been investigated; and the newborn rat has been used as a test-system in the demonstration of the roles of cellular and humoral factors in graft rejection. The literature on these topics has been reviewed. The following are results of the present investigation:

1) As a consequence of its immunologic immaturity, the newborn rat is a suitable host for the temporary survival and differentiation of both homologous and heterologous orthotopic skin grafts. Transplants heal into place and acquire a good blood supply within three days, regardless of their origin, and enjoy a subsequent five to ten days of well-being before they are destroyed by an active immunologic response by the host.

2) By challenging chronologically arranged panels of progressively older rats with hamster skin and lymphoid cells, it has been shown that the ability to react to heterologous transplantation antigens increases in intensity within three days after birth and reaches adult vigor by twenty days.

3) The ability to reject orthotopic hamster skin grafts in accelerated fashion was passively conferred on newborn rats by the adoptive transfer of lymph node cells from adult rats of the same strain. Serum from immunized adults was as effective in this regard as cells from lymph nodes actually draining skin heterografts in the process of being rejected. On this basis and other evidence, it is inferred that the heterograft reaction is mediated by species specific serologic antibody released by sensitized lymphoid cells.

4) The period of tolerance-responsiveness to homologous transplantation antigens is nearly over in three-day old Lewis rats, whereas a significant proportion of BN rats can still be made tolerant of subsequent Lewis skin homografts by the intravenous injection of Lewis bone marrow cells seven days after birth. By grafting progressively older Lewis and BN rats with BN and Lewis skin, respectively, starting at birth, it has been shown that the primary response to orthotopic skin homografts in the Lewis strain reaches adult intensity by the third day. In the BN strain, however, this state is not attained until the tenth day postpartum, and it is concluded that homograft reactivity matures seven days later in this strain.

5) The ability to reject orthotopic skin homografts in accelerated fashion was passively conferred on very young rats by the adoptive transfer of lymph node cells from adult rats of the same strain.

6) Serum prepared by immunizing adult rats with homologous lymphoid cells contained in complete Freund's adjuvant enhanced the survival of skin homografts on four-day old recipients. The same serum, shown to have both agglutinating and cytotoxic activity in vitro, when injected intraperitoneally in large quantities into adult rats, prejudiced the viability of skin homografts transplanted concomitantly. In view of recent evidence, it is possible that the normal process of skin homograft rejection by adult rats is mediated by the synergic action of sensitized lymphoid-type cells and immune serum.

Microfilm $2.75; Xerox $6.20. 126 pages.

OSTEOLOGY AND PHYLOGENY OF THE AMERICAN CYPRINID FISHES ALLIED TO THE GENUS GILA

(L. C. Card No. Mic 61-1802)

Teruya Uyeno, Ph.D.
University of Michigan, 1961

Since the middle of the nineteenth century, many recent and fossil cyprinid fishes have been described from western United States. But since their phylogeny has been imperfectly known, the classification has been quite artificial and many different generic arrangements have been proposed. This is especially true of the cyprinids here classified in the genera Gila, Richardsonius, and Ptychocheilus, which are so similar in external features that they have had a chaotic taxonomic history.

I have approached this systematic problem by stressing osteological characters, with the hope of establishing a standard base for future paleontological studies of Cenozoic cyprinids and for phylogenetical comparisons with Eurasian minnows.

In the section on comparative osteology, Gila atraria served as a type for comparison with the other species since it appears to have the most generalized form. Its skeleton is almost completely illustrated. Initially, each bone was observed in its natural position, in relation to neighboring bones, and was then removed to permit detailed examination and drawing. The variability of corresponding bones and their degree of morphological change with growth (if any) was studied, and the characters of taxonomic value were determined.

Based on the results of comparative morphology, the synonymy and characters of Gila, Richardsonius, and Ptychocheilus are described in detail. Fossil material which appears to represent the above genera was examined and is summarized in the section on paleontology. The oldest known fossil is Miocene, and there is evidence to suggest that not only were Gila, Richardsonius, and Ptychocheilus well separated by Middle Pliocene time, but Gila atraria and G. robusta may also have been evolved then.

Among these three genera, Gila is the most generalized form. Species formerly placed in the genera Siphateles and Snyderichthys are here included in subgenera of the genus Gila.

Among the species of Gila, the one that lives in the Lake Bonneville and upper Snake River basins, Gila atraria, appears to be closest to the most generalized form which gave rise to the other species. It has omnivorous food habits, a 2,5-4,2 dental formula, black peritoneum, a moderate number of lateral-line scales (44-67), a body form adapted to a lotic environment, and the most generalized skeletal structures. The subgenus Siphateles, which inhabits the Lake Lahontan basin, is very similar to G. atraria, differing primarily in the single-rowed teeth. G. caerulea and G. crassicauda are also closely related to G. atraria. Among the species of Gila in the Colorado River system, G. robusta intermedia resembles G. atraria most closely. In the Rio Grande system and streams on the Pacific slope of Mexico, the species of Gila are all similar to G. pandora, which may have been derived from the ancestral type that gave rise to G. robusta intermedia. Richardsonius includes a group of fishes which are well adapted as small carnivorous forms. Species formerly assigned to Clinostomus are combined with Richardsonius. The orbitosphenoid, dentary, endopterygoid, hyomandibular, urohyal, etc., have proven useful in separating Richardsonius from Gila. Ptychocheilus comprises a group of large carnivorous fishes, and shows the most specialized features in the form of the hyomandibular, dentary, quadrate, urohyal, branchiostegals, etc.

The hypothetical phylogeny of the genus Gila and its allies is presented in Plate XXXV.

Microfilm $2.75; Xerox $8.40. 181 pages.

THE TAXONOMY AND ZOOGEOGRAPHY OF THE ANTHRIBID WEEVILS OF THE WEST INDIES

(L. C. Card No. Mic 61-1830)

Barry Dean Valentine, Ph.D.
Cornell University, 1960

The West Indies fauna contains 22 genera and 93 species of the weevil family Anthribidae; of these, six genera and 62 species are new. A key to the subfamilies, tribes, and genera of the New World is included, as well as keys to the species of these taxa in the Antilles. Data on the distribution and relationships of each genus and species are provided.

The zoogeographic section includes discussions of the general distribution of the family in the New World, and then a detailed account of its distribution in the West Indies. This is followed by comments on the faunal characteristics of various world islands as illustrated by Anthribidae, on the significance of these characteristics to West Indies zoogeography, on distribution patterns within an island archipelago, and on the origin of the Antilles fauna.

Central America has provided the major portion of the Antilles Anthribid fauna. South America has provided a few small groups; it is significant that these stocks are peripherally distributed in South America and appear older than the dominant Brazilian fauna. The arrival of these stocks in the West Indies could have been at a time when they were more widely distributed, perhaps in Central America. Only part of one genus appears to have arrived from South America via the Lesser Antilles. Southeastern United States has provided a few species; the majority have not evolved past subspecies levels since their arrival on the islands. Africa has provided one endemic genus. Two endemic genera cannot, at present, be traced to their point of origin.

Microfilm $2.75; Xerox $8.40. 182 pages.

RECENT SOFTSHELL TURTLES OF NORTH AMERICA (FAMILY, TRIONYCHIDAE).

(L. C. Card No. Mic 61-1840)

Robert Gravem Webb, Ph.D.
University of Kansas, 1960

All North American softshells belong to the genus Trionyx, which is the most widespread of the six genera comprising the family; most genera and species occur in southeastern Asia. Three distinct species (ferox, spinifer, muticus) and one species (ater) that is not well differentiated from spinifer occur in eastern North America, and fit the well-known Sino-American distributional pattern.

There is variation in size; pattern on carapace, snout, limbs and side of head; proportions of snout, head and shell; kinds of tubercles on carapace; and features of skulls, carapaces and plastra. Some characters show geographical gradients. Females of all species are larger than males, and have the juvenal pattern replaced (prior to sexual maturity) by a mottled and blotched pattern. Most large males retain the juvenal pattern. At sexual maturity the tail elongates in males, and in those of spinifer the carapace becomes "sandpapery." In osteological characters, muticus is most distinct.

Ten kinds of Recent American softshell turtles are recognized. T. ferox, the largest species, is monotypic, confined to the extreme southeastern United States, and resembles Old World softshells more closely than it resembles any American species. In the region of sympatry, ferox and spinifer are ecologically isolated. T. spinifer is polytypic with six subspecies (two, pallidus and guadalupensis, are described as new), has the largest geographic range, and shows two different geographic clines. T. s. emoryi, occurring in the Río Grande drainage, is the most variable subspecies and has been introduced into the Colorado River drainage of Arizona. T. ater is confined to clear-water ponds in central Coahuila, México, is most closely allied to T. s. emoryi with which it seems to be sympatric, and has characteristics that indicate relationship with ferox and muticus. T. muticus is polytypic with two subspecies; its geographic range is completely overlapped by that of spinifer.

Small size and pallid coloration are correlated with arid environments. Some males of the larger species spinifer, occurring in the Río Grande drainage, are sexually mature at a size that corresponds to that of the smaller species muticus. Most females of spinifer are sexually mature at a plastral length of 18 to 20 cm., those of muticus at 14 to 16 cm. Some large females have immature ovaries. Possibly muticus limits its nest sites to open regions of sand bars, whereas spinifer does not always do so. The seasonal reproductive potential is less in northern populations (averaging 20 eggs per clutch and only one clutch per season) than in southern populations (averaging about ten eggs per clutch, but three clutches per season); eggs laid in northern latitudes are slightly smaller than those deposited farther south.

Some osteological characters and their variation in the living species are mentioned as an aid to future workers concerned with an assay of fossil remains. Fossil localities indicate a more widespread, former distribution; they occur in marine, brackish and fresh-water deposits, the oldest of which are of Upper Cretaceous age.

The characters of living softshells suggest that spinifer, ater and muticus are derivatives of a ferox-like ancestor, and differentiated in North America. Most differentiation occurs in southwestern Texas and northern México where characters indicate alliance with ferox in Florida. It is hypothesized that the aridity in the late Tertiary effected specific differentiation by the modification and isolation of aquatic habitats. Pluvial periods in the Pleistocene provided for confluence of aquatic habitats and expansion of geographic ranges, and coupled with physiographic changes, effected subspeciation.

Microfilm $6.35; Xerox $22.50. 498 pages.

SOUND PRODUCTION DURING THE WAGGLE DANCE OF THE HONEY BEE

(L. C. Card No. Mic 61-1806)

Adrian M. Wenner, Ph.D.
University of Michigan, 1961

Although the waggle dance of the honey bee (Apis mellifera Linnaeus) has been well investigated as a means by which the location of food sources is communicated among individuals in a hive, the possible use of sound by these communicating bees has heretofore not been investigated. In this study, Italian honey bees (Apis mellifera ligustica Spinola) were found to produce a pulsed sound of approximately 200 cps during the straight run part of their waggle dance. Since the ratio of the sound pulse rate to the waggle rate is approximately 2.5 to 1, the sound is not an incidental result of the waggling by the dancing bee.

A study of the relationship between the length of time sound is produced and the distance of the food from the hive was made by placing sugar syrup at various distances from the hive, individually marking bees as they collected this syrup, and tape recording the sound produced by these bees as they danced in the hive. Audiospectrographs were made of this sound and the various elements of the dance were then measured to determine how much time was spent in sound production during the straight run, in lack of sound production during the circle run, and during the complete run (total of the straight run time and the circle run time) of this dance.

The complete run time, the straight run sound production time, and the number of sound pulses were all graphically found to be more closely related with the distance of the food source from the hive than the circle run time. The straight run sound production time and the number of sound pulses produced during the straight run were graphically found to be inseparable.

The results of an analysis of variation and a consideration of the effect of wind on the signal given by dancing bees indicates that the average complete run time is largely a sum of the average straight run time and average circle run time.

The circle run time had a significant positive correlation with the distance of the food from the hive. Since the circle run time shows an inverse correlation with the

straight run time at any one distance, a longer time spent on the straight run is evidently not responsible for the positive correlation of the circle run time with distance. No explanation could be given for this positive correlation.

The following four components (or a combination of any of these four) of the honey bee waggle dance now remain as best possibilities for conveying the information about the distance of the food source from the hive:

a) the duration of waggling during the straight run
b) the number of waggles produced during the straight run
c) the duration of sound production during the straight run
d) the number of sound pulses produced during the straight run.

The analysis of wind effects on the dance revealed that bees signal the flight time out to the food source, not the flight time of the return trip.

The interpretation of the results of the step-experiments ("Stüfenversuchen") of von Frisch and co-workers (a series of experiments testing the ability of bees to perform in response to signals given by dancing bees) is questionable, since a performance much poorer than that given by the standard deviation of the results, coupled with bees visiting more than one of the unevenly spaced stations, would give similar results.

The possible use of sound by honey bees in communicating the distance of a food source from the hive is discussed.

Microfilm $2.75; Xerox $5.00. 97 pages.

SUMMARY OF PERFORMANCE MATERIALS
(Tape Recording Available at the University of Michigan School of Music Library).

Richard Sidney Collins, A.Mus.D.
University of Michigan, 1961

PROGRAM I

J. S. Bach	English Suite in G minor
Schubert	Moments Musicaux, Op. 94, Nos. 2, 3, 4, 5
Mozart	Sonata in D, K. 576
Persichetti	Fourth Sonata (1949)

PROGRAM II

Purcell	Suite in G minor
Chopin	Sonata in B minor, Op. 58
Ravel	Sonatine
Beethoven	Sonata in A-flat, Op. 110

The above compositions demonstrate the development of keyboard writing from the Baroque to the present, and the music was chosen to form balanced programs.

The suites of Purcell and Bach afford an interesting comparison of styles. Most of the Purcell suite is derived from French models, and the texture consists mainly of heavily ornamented melody over a two-part accompaniment. But for the Sarabande, Bach's use of ornamentation is more sparing, and the texture is predominantly contrapuntal.

Mozart and Beethoven are both represented by late works. The sonata of Mozart is his last for piano solo, and is striking in its contrapuntal writing, especially in the use of canon in the first movement. The last movement presents an unusual example of rondo-sonata form: with the same theme used in the A and B sections, the recapitulation of B sounds as if it were the return of the A theme, and formal interest is compounded and enriched.

The Beethoven is a remarkable example of the unification of apparently diverse elements in a single conceptual frame. This is particularly evident in the first movement. All of the thematic materials seem to stem from the same lyric impulse as that expressed in the opening measures. The themes are not similar in their organization of intervals nor in rhythmic design, but the genius of Beethoven permits these seemingly disparate elements to be heard as a single continuous expression of one idea. The last movement is a complicated structure: an introduction with recitative, an arioso, an interrupted fugue, a variation of the arioso, and finally the continuation and conclusion of the fugue. That Beethoven closed the sonata with a fugal movement is not unprecedented, but that he incorporated into this design a slow lyrical section, and interrupted the fugue to bring back a variant of this section, is of special interest.

Schubert's Moments Musicaux and Chopin's Sonata in B minor illustrate two facets of romanticism: the delightful miniature and the large-scale dramatic work. The main emphasis in each of the Schubert compositions is not virtuoso display, nor formal ingenuity, but the development of one, or at most two, musical ideas. The Chopin sonata uses the traditional classical forms, but the precise punctuation between sections of the work indicates the process of "filling in" a preconceived formal vessel, and shows the precedence of content over form.

Ravel's Sonatine (1905) is a return to the concepts of Mozart and Haydn, and as such is a forerunner of the neo-classic movement of the 1920's. Ravel has achieved in this work a blending of classical structure and tonality with impressionist harmony.

Vincent Persichetti has written, to date, ten sonatas of varying sizes, of which the Fourth Sonata is one of the largest. Persichetti's harmonies include octaves and fifths as perfect consonances, with thirds, fourths, and minor sevenths as imperfect consonances; and many varieties of dissonance, his favorite agglomeration being a minor second added to a triad, which produces a rich, biting effect.

The public programs were supplemented by illustrated lectures on the Bach English Suites, Mozart's four-hand sonatas, Beethoven's Diabelli Variations, and Stravinsky's Capriccio and L'Histoire du Soldat. Lecture-recitals were given on Bach's Toccata in C minor, Schubert's Sonata in A, Op. 120, Ravel's Valses Nobles et Sentimentales, and the Mozart and Persichetti sonatas programmed.

SUMMARY OF PERFORMANCE MATERIALS
(Tape Recording Available at the University of Michigan School of Music Library).

John Donald Mohler, A.Mus.D.
University of Michigan, 1960

Five solo appearances, including three recitals, were presented in partial fulfillment of the requirements for the degree of Doctor of Musical Arts in Performance. The programmed compositions were chosen to illustrate formal types and historical placement. Particular emphasis was assigned to the selection of seldom-performed works from the literature of the clarinet.

The first two performances were solo appearances with the University of Michigan Symphony Band. The transcribed accompaniments for these solos are a valuable addition to the repertory for this performance medium.

Duplications among several of the programs are considered valid because of the mediums of accompaniment involved and the various locations of the performances.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

I.	
Jules Demersseman	Morceau de concert, Op. 31
II.	
Henri Tomasi	Finale from the Concerto for Clarinet
André Bloch	Denneriana
III.	
Camille Saint-Saëns	Sonata in E-flat Major, Op. 167
André Bloch	Denneriana
IV.	
Karl Stamitz	Andante moderato from the Concerto in E-flat Major
Mátyás Seiber	Concertino
Igor Stravinsky	Three Pieces for Clarinet Unaccompanied
Philip Cardew	Scherzo
V.	
Ignacy Feliks Dobrzyński	Concerto in A-flat Major
Felix Mendelssohn Bartholdy	Two Concert Pieces for Clarinet, Basset-horn, and Piano Op. 113 Op. 114
Paul Pierné	Andante-Scherzo
Igor Stravinsky	Three Pieces for Clarinet Unaccompanied
Henri Tomasi	Concerto

Composers such as Mozart, von Weber, and Spohr, whose names are often associated with the clarinet concerto, are not represented here. Nevertheless, the solo concertos of Karl Stamitz (1745-1801), Dobrzyński (1807-1867), Seiber (b. 1905), and Tomasi (b. 1901) demonstrate the formal evolution of the clarinet concerto and the increase in technical demands required of both the performer and the solo instrument itself.

The solo part of the Karl Stamitz concerto is scored predominantly in the clarion register of the clarinet. Extensions of this range into the chalumeau and the high registers are few because of the problems of intonation and control encountered on the instrument of the period. The concerto of the obscure nineteenth-century Polish pianist-composer, Dobryzński, runs counter to the virtuosic exhibitions of von Weber and Spohr. Here the clarinet and the orchestra collaborate on a more equal basis. The Seiber Concertino, completed in 1926, consists of five short movements in the neo-classic vein. Fully exploiting both the technical and the lyrical potentialities of the clarinet, the concerto of Tomasi is one of the most recent additions to the repertory (1953). Notable are the developmental function of the first movement's cadenza, the cyclic thematic treatment, and the harmonic language which includes the use of both polytonality and quartal harmony.

Among the last compositions written by Saint-Saëns are four works for solo woodwind instruments. One of these is the Op. 167 clarinet sonata (1921). Although lacking the depth of the more familiar sonatas of Brahms, this is a lucid example of the composer's careful consideration of the clarinet's capabilities.

Stravinsky's unaccompanied pieces represent the best-known of the very few examples of this type to be found in the literature of the clarinet. Written in 1919, these pieces illustrate Stravinsky's concern for rhythmic dynamism as well as instrumental color. While the A and the B-flat soprano clarinets are usually scored interchangeably for technical efficiency, Stravinsky uses their differing timbres as a means of achieving a brilliant climax.

The basset-horn was an extremely popular member of the clarinet family in the late eighteenth and the early nineteenth centuries. The Mendelssohn Concert Pieces (1833), effective melodious works, were inspired by the fine playing of Heinrich (1784-1847) and Carl Baermann (1811-1885), a famous father-and-son team of clarinetists. About 1850 began a period of disuse of the basset-horn. This was ended early in the twentieth century by its inclusion in several scores of Richard Strauss. Roger Sessions, Frederick Converse, and others have since continued this practice.

Finally, any presentation of representative literature of the clarinet would be incomplete if characteristic solos by French composers such as Demersseman (1833-1866), Pierné (1874-1952), and Bloch (b. 1905) were to be ignored.

SUMMARY OF PERFORMANCE MATERIALS
(Tape Recording Available at the University of Michigan School of Music Library).

Donald Herbert Sandford, A.Mus.D.
University of Michigan, 1961

The following recitals were offered in partial fulfillment of the requirements for the degree of Doctor of Musical Arts:

I. January 21, 1960, with the College Orchestra of Central Missouri State College, Hugh Williams, conductor

Tibor Serly, Concerto for Viola and Orchestra (1930)

II. July 6, 1960, with Mary Jane Sandford, pianist

Marin Marais, Suite in D minor
Ludwig van Beethoven, Notturno in D major, Opus 42
Paul Hindemith, Sonata (1939)

III. August 5, 1960, with Mary Jane Sandford, pianist

Johann Sebastian Bach, Partita in A minor
Leslie Bassett, Sonata (1956)
Darius Milhaud, Deuxieme Sonate, Opus 244
Johannes Brahms, Sonata in E-flat major, Opus 120, No. 2

The materials of these programs were selected as representative of viola literature in the various periods and styles of musical composition. Emphasis was placed on compositions from the twentieth century, since until about the year 1920, composers neglected to exploit the possibilities of the viola as a solo instrument, presumably because skilled performers were not common. The baroque era, which offers particularly rich opportunities for the selection of works which can be adapted to the tonal coloring and technical possibilities of the viola, is represented by transcriptions.

The Marais Suite is a typical, loosely organized French suite derived from the five volumes of his Pièces de viole avec la basse continüe, and exhibits the French penchant for descriptive titles and delicate ornamentation. The Partita by Bach contains elements of both church and chamber sonatas. It consists of a toccata-like Prelude, an Adagio in modified A-B-A form, an Allemande, and a Gigue.

The Beethoven Notturno stands at the brink of the nineteenth century and presents characteristics of the eighteenth-century classicism of Haydn and Mozart and of the romantic forces which were to exert such strong influences on music in the years immediately following.

Brahms's Sonata—his last instrumental work—appeared almost one hundred years after Beethoven's Notturno, at the end of the romantic epoch. The sonata has a curious relationship to that work, since Beethoven's work is a youthful one which looks forward enthusiastically to the romantic period, while that of Brahms looks back nostalgically and somewhat regretfully upon it. As such, the rich, full-bodied melodies and harmonies of Brahms contrast sharply with and present very different problems from those of the light-textured graces of the Beethoven work.

The exploration and exploitation of the viola's particular qualities and the expansion of its technique as a virtuoso solo instrument begins with the twentieth century and is a reflection of the period's search for new instrumental media as well as for new melodic, harmonic, and rhythmic materials. The four works performed represent various trends which have asserted themselves during the first half of the century.

The Serly Concerto, a virtuoso work cast in the traditional three-movement mold, complete with a cadenza, is permeated with the influences of Hungarian folk music. It is rhapsodic, having many changes of tempo, folk-like melodies and rhythms. It is an excellent example of the folkloristic trend of which Béla Bartók was the leading exponent.

The Hindemith Sonata exemplifies the neo-classic, neo-baroque group of composers. It is in the classical four-movement pattern with a Scherzo in place of the minuet. It makes frequent use of baroque contrapuntal devices in conjunction with classical sonata structures. Irregular rhythms and meters, parallel chords, quartal harmonies, impressionistic effects, and parody are combined with humor and seriousness of purpose in a masterly way.

The Milhaud Sonata, with its light-hearted spirit of divertissement, is as thoroughly French in flavor as the Hindemith work is German. It preserves the French taste for descriptive titles on the movements, as well as the baroque characteristic of maintaining a single mood throughout each. Polytonality, parallelism, quartal harmony, polyrhythm, jazz-like syncopations, and an impressionistic interest in tone colors are characteristic.

The Bassett Sonata is the newest of the works presented. Its four movements consist of a pair of successive fast, rhythmic movements preceded and followed by slow, rhapsodic movements, the last being reminiscent of the preceding ones. The style of writing is highly chromatic, but not of the twelve-tone variety, with considerable emphasis on minor seconds and ninths, and major sevenths. Its melodies are angular and cover extreme ranges of the instrument. The rhythms are irregular and are based on jazz idioms.

The series of concerts represents a wide variety of styles and periods and offered an opportunity to survey many facets of the performer's art in a relatively short period of time. Considerable insight was gained into works which were demanding in stylistic matters as well as in the purely technical problems of the exacting virtuoso elements encountered.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

ERRATA

These are noted by page number, column, author's last name, and line number. Corrections are double underscored.

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